HAWAIIAN ISLANDS & PACIFIC ISLANDS
NATIONAL WILDLIFE REFUGE COMPLEX
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TRIP REPORT TO PALMYRA ATOLL, 16-30 SEPTEMBER 1987*

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Itinerary:

16 September - travel from Honolulu/Christmas Island via Air Tungaru Board NEI MATABURA and depart Christmas Island at 1600 en route to Palmyra Atoll

17 September - en route to Palmyra via NEI MATABURA

18 September - arrive Palmyra Atoll, reconnaissance Palmyra Atoll

19 September - bird survey Palmyra Atoll
800-1300 - south side Cooper Island, Fighter Island causeway and Fighter Islands
1300-1430 - Lost Island, west shore of Papala Island, west shore of Eastern Island, south shore of Whippoorwill Island, south shore of Quail Island, East side of causeway.

20 September - bird survey Palmyra Atoll
730-1300 - Home Islands(entire), Paradise Islands(west and south shore), Kaula(south shore), and back down north shore of Kaula, Paradise.
1400-1800 - Quail and Whipoorwill Is (entire, to break in causeway at Whippoorwill Is, Eastern Is)

21 September - turtle and bird survey Palmyra Atoll
0830-1000 - turtle survey along outside reef edge - Home Island to Barren Island
1000-1430 - bird survey Barren Island(entire), Portsmouth Island(entire), north shore of Eastern Is to break between Eastern Is and Whippoorwill Is
1430-1600 - bird survey interior Eastern Is and west shore Eastern Is turtle survey pool in reef east of Eastern Is

22 September - bird survey Palmyra Atoll
0815-1300 - Holei Is(entire), Bird Island(entire), Papala Island(entire)
1300-1630 - North shore Cooper Is west to Strawn Is(Strawn Pt.), back through interior and south shore of Strawn/Cooper Is.

23 September - bird survey Palmyra Atoll
0815-1030 - Sand Island(entire), other three dredge disposal islands in lagoon known as Brothers Is(entire)
1030-1600 - Aviation Is(entire), Quail Is(entire), Whipoorwill Is(entire), south shore of Aviation Is, Cooper Is

24 September - turtle and bird survey Palmyra Atoll
0800-1030 - turtle survey north shore of atoll outside of breakers on reef from Strawn Pt to Portsmouth Is
1300-1500 - bird survey Cooper Is interior

25 September - turtle nesting pit survey Palmyra Atoll
0815-1130 - nesting pit survey - Cooper Island sand beach on north shore
1200-1630 - nesting pit survey Paradise Is to Bird Is, south shore

26 September - depart Palmyra via NEI MATABURA at 1030

27 September - en route to Christmas Island, stop at Fanning Is(arrive 800, depart 1530)

28 September - Arrive Christmas Is 830, Arrive Hotel 1030, clean up, repack, logistic arrangements, etc.

29 September - conduct studies of seabirds in plots established by cooperating scientist Dr. Ralph Schreiber, LA County Museum. Checked plots for masked boobies in area of Southeast Point, general populations and phenology survey on Motu Upua, and great frigatebird and red-footed booby plots on boating lagoon islands

30 September - travel Christmas Island to Honolulu via Air Tungaru, arrive Honolulu duty station at 1300.

Personnel:

Stewart I. Fefer, Refuge Complex Manager, U.S. Fish and Wildlife Service, Pacific Islands Office, Refuges and Wildlife Resources, Honolulu HI
Darrel Herbst, Botanist, U.S. Fish and Wildlife Service, Pacific Islands Office, Environmental Services, Honolulu, HI
Helene Takemoto, Planner, U.S. Army Corps of Engineers, Pacific Ocean Division, Fort Shafter, Honolulu, HI
Charles Strech, Archeologist, U.S. Army Corps of Engineers, Pacific Ocean Division, Fort Shafter, Honolulu, HI
James Maragos, Marine Biologist, Chief, Environmental Branch, U.S. Army Corps of Engineers, Pacific Ocean Division, Fort Shafter, Honolulu, HI
Don Schlack, Contractor to Corps of Engineers, contaminant sampling
Ainsley Fullard-Leo, Contractor to Corps of Engineers, location of debris left by military on Palmyra Atoll, one of three co-owners of Palmyra Atoll

Introduction and Purposes

The present survey was conducted as part of a U.S. Army Corps of Engineers exploratory program involving locating and sampling potential contaminants left on Palmyra Atoll during the military occupation of the area during World War II. The primary purpose of the wildlife survey reported here was to identify important wildlife resources of Palmyra Atoll and to determine if there are potential effects of a possible contaminant cleanup operation.

Another survey purpose was to determine the value of Palmyra Atoll as a wildlife habitat. By becoming more familiar with the wildlife values and site specific habitat requirements of the various wildlife resources of Palmyra, the U.S. Fish and Wildlife Service(Service) would be better able to evaluate the effects of projects proposed for Palmyra Atoll in the future.

This report focuses on the results of the wildlife resource surveys conducted on Palmyra Atoll during the period from 18-26 September 1987.

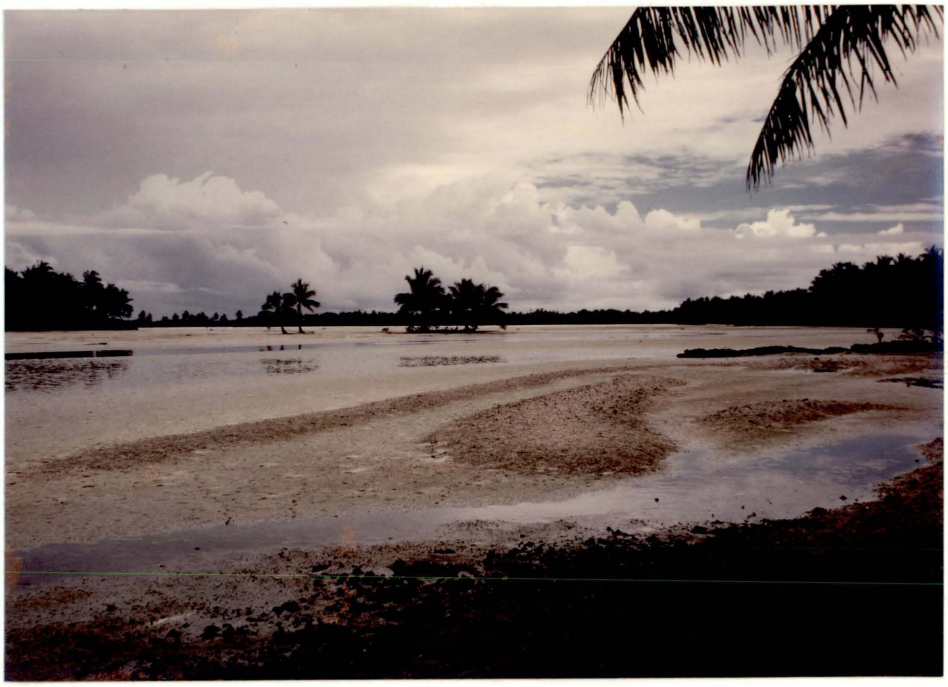
Information from summary reports prepared by Roger B. Clapp of the Fish and Wildlife Service, National Ecology Center, National Museum of Natural History, Washington, D.C., from data collected during visits to Palmyra Atoll during 1964 and 1965 as part of the Smithsonian Institution's, Pacific Ocean Biological Survey Program, is included in the summary of prior records for species presented here.

The Atoll

Physical description: Palmyra Atoll(Figure 1) is a small atoll of elongate shape consisting of a reef, roughly 10 miles long in an east-west direction and 1 1/2 to 2 miles wide from north to south(Dawson 1959). It is located about 960 nautical miles south and west of Honolulu and 350 miles north of the equator. The atoll receives more than 100 inches of rain per year.

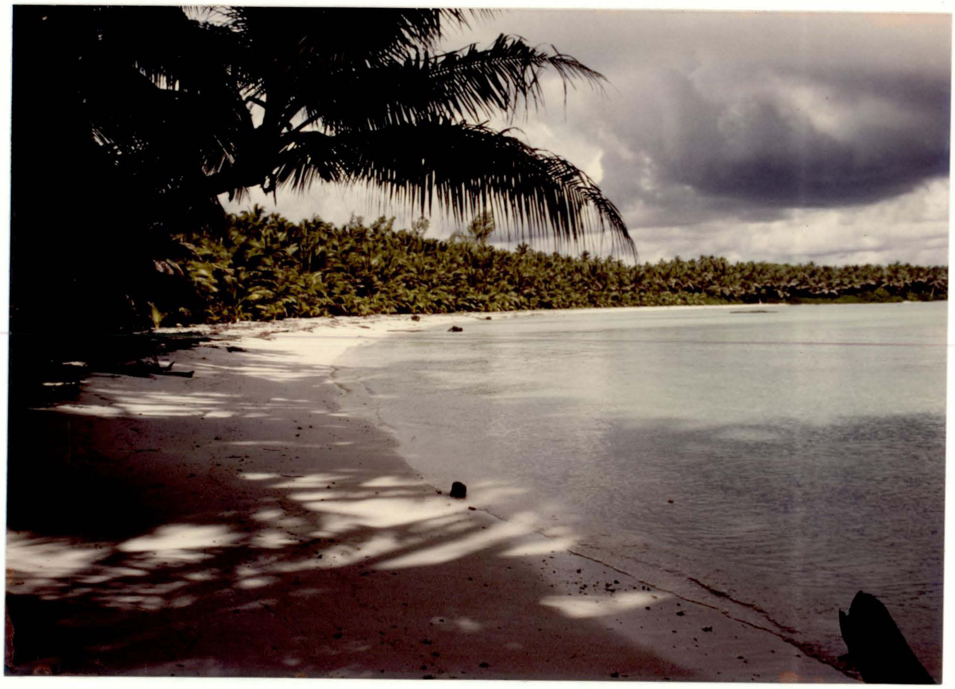
The terrestrial portion of the atoll presently consists of a number of vegetated islets, most of which are interconnected by causeways constructed by the military during World War II. The size and shape of most islands was modified by the military at this time and some islands were created or their formation hastened by the modification of the atoll. Other islands were deliberately formed to create runways and for disposal of dredge spoil when the boat channel was created. Presently, several breaks occur at various locations in the causeways resulting in separation of some of the islets. The islands stand at about 5-6 feet above sea level. A detailed history of the physical changes at Palmyra Atoll is presented in Dawson (1959).

A conspicuous feature of Palmyra Atoll is the breadth of wetland habitat consisting of significant area of intertidal flats comprised of coral mud which exist inside the lagoon. Due to modification of the atoll during World War II, much of the area of former live coral reef flat in the interior laggon has become intertidal mudflat due to modification of the circulation of the tides and currents through the atoll. Extensive reef flats extend seaward from the islands on the north, south and west shores. On the north and south the reef flats may extend to half a mile from the islands and on the west side they any extend a mile from the nearest shore.



Coral mudflats, center lagoon, Palmyra Atoll. (SF)

Wide sand beaches are quite limited on this atoll, especially at high tide. The only sand beach of any consequence is the beach located on the northwest shore of Cooper Island. Most of the other sand beaches on Palmyra Atoll are narrow beaches exposed at low tide and covered by high tide up to a coral rubble berm. The vegetation (commonly Tournefortia, Scaevola, Pisonia or Cocos) of the islands grows up to the mean high tide line and drapes over the beaches.



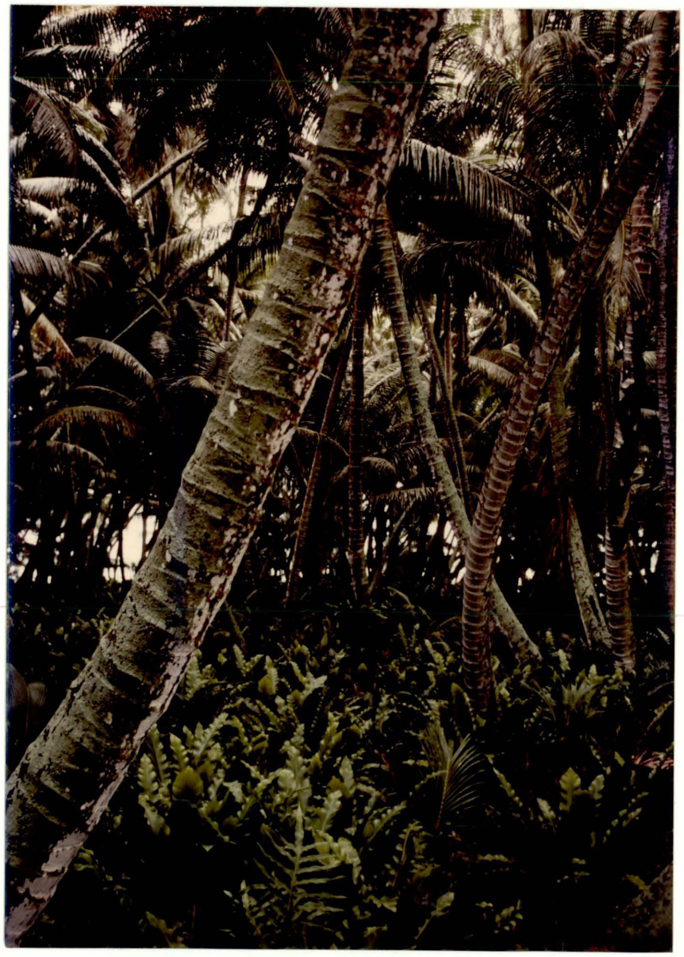
Sand Beach, Cooper Island, Palmyra Atoll. (SF)

Sand Beach, Paradise Island, Palmyra Atoll. (SF)

Land Vegetation: The land vegetation of Palmyra Atoll has also been altered significantly by man. Darrel Herbst conducted surveys of the land vegetation on Palmyra Atoll during this expedition and will report on the vegetation types occurring on each island of this atoll as well as list the species which occur on Palmyra. Herbst's report should be referred to for a description of terrestrial habitat types available for the wildlife resources of Palmyra Atoll.

In general, islands of Palmyra Atoll consist of varied vegetation types. Certain islands consist primarily of early successional vegetation such as *Lepturus* intermixed and dominated by *Scaevola* and *Tournefortia*. Other islands are dominated primarily by *Cocos* with an understory of ferns. Along the shorelines of many islands are dense stands of *Tournefortia* and *Scaevola*. Areas of several islands are stands of *Pisonia* forest. Many Many islands consist of a variety of these types.

Tournefortia dominant habitat type,
Paradise Island, Palmyra Atoll. (SF)



Coconut palm dominant habitat type, Kaula Island, Palmyra Atoll. (SF)

Tournefortia dominant shoreline, south shore, Palmyra Atoll. (SF)

Pisonia dominant habitat type, Holei Island, Palmyra Atoll. (SF)

Birds: Twenty-nine species of birds have been recorded at Palmyra Atoll but over half of these are accidental, irregular rare visitors and uncommon migrants (Table 1). Prior to this expedition, Clapp (unpublished) reported twenty eight species of birds for Palmyra Atoll. During this expedition, 18 species were recorded at the atoll, one of which is a new record (cattle egret).

The breeding birds (residents) of Palmyra Atoll consist of 10 species of seabirds. Six species of shorebirds are the most common migrants occurring at Palmyra. Several species of waterfowl(6), gulls(2), and the cattle egret are considered as accidentals at Palmyra Atoll. Seabirds such as the Audubon's shearwater, lesser frigatebird, and crested tern are rare visitants to this atoll. The only introduced bird, the crested mynah, is no longer present.

Mammals: There are no native land mammals on Palmyra Atoll. Two introduced species of land mammals presently occur on Palmyra Atoll, the black rat (*Rattus rattus*) and the domestic dog (*Canis canis*). Other introduced species of mammals undoubtedly occurred on Palmyra Atoll in the past.

Marine mammals occurring within the lagoon at Palmyra Atoll during this visit include pilot whales and bottle-nosed porpoises.

Table 1. Avifauna of Palmyra Atoll (adapted from Clapp unpublished)

Species	Status
Audubon's shearwater	Rare visitant
White-tailed tropicbird *	Uncommon resident
Red-tailed tropicbird *	Uncommon resident
Masked booby *	Uncommon resident
Brown booby *	Common resident
Red-footed booby *	Abundant resident
Great frigatebird *	Common resident
Lesser frigatebird *	Rare visitant
Sooty tern *	Abundant resident
Crested tern	Rare visitant
Brown noddy *	Common resident
Black noddy *	Abundant resident
White tern *	Common resident
Lesser golden plover *	Abundant migrant
Ruddy turnstone *	Abundant migrant
Wandering tattler *	Abundant migrant
Bristle-thighed curlew *	Abundant migrant
Sharp-tailed sandpiper *	Uncommon migrant
Sanderling *	Uncommon migrant
Mallard	Accidental
Pintail	Accidental
green-winged teal	Accidental
Eurasian widgeon	Accidental
American widgeon	Accidental
Shoveler	Accidental
Laughing gull	Accidental
Franklin's gull	Accidental
Cattle egret *	Accidental
Crested mynah	Introduction (extinct)

* = observed during 18-26 September 1987

Amphibians and Reptiles: Clapp (unpublished) reported one species of amphibian (Marine toad), two species of lizards and a marine turtle (green sea turtle) from Palmyra Atoll as a result of Pacific Program surveys in 1964 and 1965. During this expedition no surveys were conducted of land reptiles and amphibians. Green sea turtles were surveyed during this trip and were recorded as nesting for the first time.

Species Accounts

Birds

Methods:

The following definitions are used in this section to describe the methods used to determine the reported current status.

crude estimate: A crude estimate of tree and shrub nesting species was based on a direct count of nests and/or adults. It is a crude estimate because of the likelihood of nests/birds missed in the dense growth. On certain islands with large populations of a variety of shrub and tree nesting species, direct counts were not possible but counts of active/inactive nests and adult/immature birds of the species present were estimated while walking through the colony. The dense habitat on islands of Palmyra Atoll precluded more exact estimates for shrub and tree nesting species as it was very difficult to observe nests through the dense growth.

direct count: Each bird, nest, egg and/or chick was counted individually.

sample count: This method was used in the large sooty tern colony. The number of eggs and adult birds on the ground in different areas were estimated on the colony using binoculars. The size of the sampled area and the size of the entire habitat type within the colony was estimated. The population for each habitat type was extrapolated from these data. The population estimate for each habitat type was added to indicate the estimated colony size.

Audubon's shearwater (*Puffinus Iherminieri*)

Current status: Rare visitant. This species was not observed on the atoll during this visit.

Prior records: Clapp (unpublished) reported this species as a rare visitant. This species was observed on the atoll during a visit by Pacific Ocean Survey biologists during 1964-1965.

White-tailed tropicbird (*Phaethon lepturus*)

Current status: Uncommon resident. Six white-tailed tropicbirds were observed by direct count on Palmyra Atoll during this visit. Five of the six individuals observed were flying in the vicinity of specific areas of Eastern, Holei and Kaula Islands. At specific locations on these islands birds were observed on more than one visit. No nests were located but the fact that birds were apparently flushed from trees (*Cocos* and *Pisonia*) and were observed flying back and forth in the vicinity of these trees suggests that nesting may occur though probably in small numbers.

Prior records: Clapp (unpublished) reported that a maximum population of 2 birds was observed during April 1964 and again in mid-March 1965; one was observed in June 1964 and none in September,October and November, 1964. There were no records of this species at Palmyra prior to this time.

White-tailed tropicbird, Eastern Island, Palmyra Atoll. (SF)

Red-tailed tropicbird (Phaethon rubricauda)

Current status: Uncommon resident. A total of 10 red-tailed tropicbirds were observed by direct count during this visit. One nest with a partially feathered chick was found on the eastern causeway between the two Fighter Islands. This nest was found under heavy growth of Tournefortia. Undoubtedly, more birds nest on the atoll.

Prior records: Pacific Ocean Survey observations resulted in a maximum population estimate of 8 birds in June, 1964 and a minimum of 0 in November, 1964 and March, 1965. One nest was found in April 1964 (Clapp unpublished) Cameron (1923) recorded this species at Palmyra Atoll.

Red-tailed tropicbird on nest,
Fighter Island Causeway, Palmyra Atoll. (SF)

Masked booby (Sula dactylatra)

Current status: Uncommon resident. Two adult masked boobies were observed on the ground; one on the causeway east of Fighter Islands and one on the northern Fighter Island. Both birds were roosting in open habitat. These birds were site tenacious and, therefore, not readily flushed from the area when approached. No nests were found during this visit. This species may be nesting on the atoll at other times of year.

Prior records: Clapp (unpublished) reports that Pacific Ocean Survey biologists observed masked boobies flying over Palmyra in April 1964 but none were seen during other visits. They found no evidence of breeding. As reported by Clapp (unpublished), earlier observations of masked boobies on Palmyra include Streets' (1877a, 1877b) doubtful record which was probably a misidentified brown booby and Rock's (1916) description of a booby which was probably a masked booby. During the Templeton-Crocker Expedition of 1913, three specimens of masked booby were collected on Palmyra (Davidson(1934).

Brown booby (Sula leucogaster)

Current status: Common resident. A total population of 600 birds was recorded on Palmyra as a result of a direct count of birds. A direct count of nests resulted in observations of 286 nests. Nests were located in areas under dense Tournefortia and large Scaevola shrubs. Nesting areas were usually separated from other areas by a break in the land creating an island. Of 243 nests checked for contents, 60% had eggs, 40% were empty and only one nest had a chick which had very recently hatched. Most (243) nests were on the Fighter Islands causeway, an area separated from the rest of the islands of the atoll by a break in the causeway. The isolated Lost Island also had several (30) nests. The island area formed by breaks in a former causeway on the southeast side of Cooper Island, an island bunker adjacent to Quail Island and the fuel pier causeway of Paradise Island also supported nests. Roosting birds were primarily associated with nesting areas although the large Pisonia trees on Eastern Island, the Tournefortia along the shoreline of Sand Island and the smaller islets in the lagoon entrance area also supported roosting populations of brown boobies.

Prior records: Pacific Ocean Survey biologists consistently estimated the brown booby populations here at several hundred birds with a minimum population of 200 recorded in April 1964 and a maximum population of 600 recorded in November 1964 (Clapp unpublished). As mentioned above under masked boobies, observations recorded in Streets (1877b) is probably in reference to a brown booby (Clapp unpublished). Richardson (1953) recorded brown boobies as seen on Palmyra in September 1953.

Masked and brown boobies, Fighter Island Causeway,
Palmyra Atoll. (SF)

Red-footed booby (Sula sula)

Current status: Abundant resident. A direct count of birds and nests of this species resulted in a conservative crude estimate because of the difficulty in counting birds of this species in the dense habitat of Palmyra, the habits of the birds which results in them roosting on the tops of tall trees and the fact that the roosting population varies with time of day, weather and other factors. A total population of 6500 birds was estimated on the atoll during this visit based on counts conducted during the mid-day period (800-1700). This number is considered conservative. A crude estimate resulted in a total number of 2100 nests present on Palmyra during this visit. Most nests had full size downy or partially feathered chicks though nests with eggs and fully grown chicks were recorded. The nesting observed during this visit was apparently preceded by nesting earlier in the year as there were many fully grown chicks already fledged on the islands. It is likely that this species nests year round on Palmyra.

This species is distributed thoughout the atoll with lowest populations recorded on Cooper Island, and areas dominated by Cocos. On islands dominated by Cocos, nesting occurred on the shoreline where Tournefortia was present. The preferred nesting and roosting habitat was Tournefortia and Pisonia. The largest nesting populations were recorded on Eastern Island and Sand Island and large numbers were also recorded on the north and west shore of Holei,Bird and Papala Island where large stands of Pisonia occur.

Prior records: Pacific Ocean Survey biologists estimated a maximum population of this species of 25000 in mid-March 1965 and a minimum population of 8000 in June and November 1964. A maximum number of nests of 1500 was recorded in November 1964 (Clapp unpublished). The apparent difference between the total populations recorded in the 1960's and the present population is likely an artifact due to variation in the time of day of the survey, the time of year of the survey in relation to the chronology of bird usage, differences in sampling technique and observer variation. The estimate of the number of nests recorded during the present survey was higher than that recorded by the Pacific Ocean Survey Program even though the total number of adults recorded was lower.

Certain earlier visitors to Palmyra noted the presence of red-footed boobies but did not indicate numbers. Red-footed boobies were recorded as present and nesting on Palmyra by Rock (1916) and by Richardson (1953) who reported several hundred as present.

Red-footed booby adult and chick, Palmyra Atoll. (SF)

Great frigatebird (Fregata minor)

Current status: Common resident. A direct count of nests and birds resulted in a crude estimate because of the difficulty in observing this species which commonly occurred at the very top of large Pisonia trees on the islets of Palmyra Atoll. Nesting and roosting populations of this species were probably significantly underestimated because of the difficulty in censusing birds that may have been concealed by the dense vegetation. The population estimate here is a minimal number of great frigatebirds using the atoll and the actual total numbers using the atoll may be two to three times higher than the numbers estimated. A total of 200 birds and 65 nests were estimated from a direct count during the mid-day (800-1700) counts conducted. The largest population of birds was in the dense Pisonia trees of Eastern Island, followed by the nearby Lost Island and Papala Island. Of the three nests where contents could be observed, downy chicks with scapular feathers emerged were present. A few (2-3) adult male birds were observed with inflated pouches.

Prior records: Pacific Ocean Survey biologists recorded a maximum population of 200 great frigatebirds in April, June and November 1964 and a minimum population of 100 in March 1965 (Clapp unpublished). Earlier visitors to Palmyra recorded the presence of frigatebirds but few have given any indication of numbers or breeding status (Clapp, unpublished). Streets (1877a) recorded frigatebirds on Palmyra and stated that they were not breeding in mid-Decmber 1873. Rock (1916) indicated frigatebirds were nesting in the treetops in mid-July 1913. In 1953, Richardson reported over a hundred in mid-September but found no nests. Dawson (1959) stated that trees of the eastern islands were filled with breeding boobies and frigatebirds during the fall.

Lesser frigatebird (Fregata aeriel)

Current status: One lesser frigatebird male was observed flying over the atoll during this visit.

Prior records: Sibley and Clapp (1966) reported a single adult male over Palmyra Atoll in April 1964.

Sooty tern (Sterna fuscata)

Current status: Abundant resident. Three distinct colonies were present during this visit. A sample count of sooty terns was conducted on Cooper Island and a crude estimate was conducted on the Cooper Island and Fighter Island causeway colonies. The total population of sooty terns at Palmyra Atoll during this visit was estimated as 260,000. The total number of nests was estimated as 126,000.

The total population of sooty terns estimated on Cooper Island was 250,000 total birds. A total of 125,000 eggs were estimated. This colony was located on the eastern portion of the former runway with most of the birds roosting and nesting on the packed coral surface of the runway. This eastern portion of the runway was dominated by Lepturus repens grass. On the Cooper Island causeway located on the southeast portion of Cooper Island, 5000 sooty terns were on the ground roosting and 1000 eggs were observed. On the eastern causeway between the Fighter Islands, an estimate of 5000 adults resulted from the survey. No eggs were observed here.

Sooty terns were just beginning a nesting cycle during this visit. No young were observed in any nests nor were any fledglings observed on the atoll. During our first visit to the sooty tern colony on Cooper Island, one of the dogs followed us to the colony site. The dog would bite at uncovered eggs and broke open two eggs before we stopped the dog. These eggs were both recently laid and had no apparent embryos formed.

In all instances, the birds nested in open habitat; on coral rubble on the Cooper Island causeway, on coral flat on the Fighter Island causeway and on the packed coral runway on Cooper Island. Significant egg predation by rats was noted in the Cooper Island runway colony. Crushed eggs were common throughout the colony.

Prior records: Sooty terns have been recorded on Palmyra since the middle of the nineteenth century. Lucatt (1851) first recorded eggs of the sooty tern in July, 1848. Streets (1877a) reported sooty terns on eggs in mid-December, 1873. Baker (1954) reported the presence of sooty terns which were not nesting during the summer of 1922. Munro (1938) reported young on the wing in May 1938. Richardson (1953) heard a colony of sooty terns on the island but did not locate them. Pacific Ocean Survey biologists found some nestlings present in late January and early February, 1964 (Clapp unpublished). In June-July 1964 large numbers of terns were over the island but not nesting. In February 1965, nests were with eggs on Cooper Island. The minimum populatin of sooty terns recorded by the Pacific Ocean Survey Program was 500 in November 1964. In March 1965, 1,000,000 birds were recorded with 500,000 eggs present (Clapp unpublished). King (1973) reported that maintenance and use of the runway by the National Center for Atmospheric Research in 1967 resulted in wholesale death and nest abandonment of sooty terns. Apparently, sooty terns are again using the former runway for nesting.

Sooty tern colony, Cooper Island runway, Palmyra Atoll. (SF)

Sooty tern colony, Cooper Island runway, Palmyra Atoll. (SF)

Brown noddy (Anous stolidus)

Current status: Common resident. A crude estimate based on a direct count of brown noddies resulted in a population of 400 birds on the atoll during this visit. This is considered an underestimate as this species is very difficult to survey in this densely vegetated atoll. The largest concentration of this species was on Sand Island where 300 birds were estimated and 5 nests were located. Eastern Island was the next largest colony with 50 birds and 10 nests located. Of about 5 nests in which the contents could be observed, there were 1 egg, 2 downy chicks and 2 mostly feathered chicks. There were some flying young observed.

Most of the birds observed were roosting and nesting in Pisonia and Tournefortia. Several were observed roosting and nesting in Cocos. Nests were in Pisonia and Tournefortia were located within 20 feet of the ground but nests in Cocos were often as high as 30 feet from the ground.

Prior records: Clapp (unpublished) reported that Pacific Ocean Survey Program population estimates of brown noddies varied considerably between visits. Numbers ranges from a low of 100 in early April 1964 to a high of 2000 in mid-March 1965. In late-Novemebr 1964, 1500 birds were estimated as present. As black noddies and brown noddies are difficult to distinguish, early records grouped the species and considered them as either black or brown noddies. Streets (1877), Rock (1916), and Bryan (1937) reported one species of noddy as present. Richardson (1953) reported the black noddy but pointed out that there was difficulty in distinguishing species. Clapp (unpublished) suggests that from the observations and the incongruity of these earlier records, Palmyra Atoll has long been a breeding site for both species of noddy.

Black noddy (Anous minutus)

Current status: Abundant resident. A crude estimate of 3500 birds and 1100 nests resulted from the survey during this visit. Three thousand birds and 1000 active nests were estimated on Sand Island. About 1000 old, unoccupied nests were also observed here. Nests were located too high for observation of contents but most occupied nests apparently contained eggs or young chicks judging from the behavior of the adults on the nest. Only 2 chicks, both partially feathered, were observed. Smaller colonies of this species were located in the Pisonia forest areas of Eastern Island, Holei Island, and Papala Island.

Prior records: Pacific Ocean Survey Project biologists recorded a maximum population of 8000 birds (1000 nests) in late-November 1964 and a minimum population of 750 in mid-April, 1964. A maximum number of nests of 2500 was recorded in March 1965 when 5000 adults were estimated as present (Clapp unpublished). See discussion under brown noddy above for information on observations from earlier surveys.

White tern (Gygis alba)

Current status: Common resident. A crude estimate of white terns resulted in a population of 508 birds present. This species was nesting in small numbers during this visit. Two eggs, 1 downy chick, one partially feathered chick and two fully feathered chicks not quite flying were observed. Many of the birds (200) and nestings (3) were on Sand Island. Papala Island and Eastern Island also had many birds and breeding was also observed on these islands. Birds were observed roosting or flying on most of the islands in the atoll during this visit. Nests were found in Pisonia and Tournefortia trees.

Prior records: Clapp (unpublished) reports that Pacific Ocean Survey Project biologists estimated a maximum population of 200 and a minimum population of 100 during visits in 1964 and 1965. These estimates were not considered very accurate. White terns were recorded frequently in the earlier records including popular accounts of the atoll (Cooper 1913, Meng 1923, Rock 1929) as well as more scientific accounts of the visits to the island (Streets 1877a, 1877b; Rock 1916, Munro 1938 and Richardson 1953). Few have indicated breeding status and only Richardson includes a population estimate (several hundred) based on results from his visit in September 1953.

White tern chick, Palmyra Atoll. (SF)

Lesser golden-plover (Pluvialis dominica)

Current status: Abundant migrant. 75 lesser golden plovers were recorded via a direct count during this visit. Most birds were observed at low tide in the coral mud flats found in the interior lagoon.

Prior records: A maximum of 500 birds was recorded in April 1964 and a minimum of 50 in June 1965 and March 1965 (Clapp unpublished). Many early visitors to Palmyra recorded the presence of this species (Streets 1877, Rock 1916, Baker 1954, Richardson 1953, Munro 1944, Bryan 1940).

Ruddy turnstone (Arenaria interpres)

Current status: 112 ruddy turnstones were estimated on Palmyra via a direct count during this visit. This species was observged in areas of coral flats at low tide and along the sand beaches of the atoll.

Prior records: Clapp (unpublished) reported a maximum population of 300 birds recorded by the Pacific Ocean Survey Project in November 1964 and a minimum population of 6 recorded in March 1965. Pacific Ocean Survey biologists (Clapp unpublished) and Richardson (1953) observed very few birds of this species in late September.

Wandering tattler (Heteroscelus incanus)

Current status: Abundant migrant. 104 birds of this species were recorded via a direct count during this period. Birds were observed on beaches and on coral flats.

Prior records: A maximum of 300 birds were obseerved by Pacific Ocean Survey Program biologists in November, 1964 and a minimum of 15 in June 1964 (Clapp unpublished). Richardson (1953) observed more than 40 birds in Septmber, 1953.

Bristle-thighed curlew (Numenius tahitiensis)

Current status: Abundant migrant. Two hundred one bristle-thighed curlews were recorded via a direct count during this visit. Birds were observed in the interior of most islands, on the beaches and the coral flats.

Prior records: A maximum population of 100 birds was recorded by Pacific Ocean Survey Program biologists during September, October and November, 1964 (Clapp unpublished). Street (1877), Rock (1916), Richardson (1953) and Baker(1954) recorded this species on the atoll. Richardson recorded 40 birds present in mid-September.

Sharp-tailed sandpiper (Calidrus acuminata)

Current status: Uncommon migrant. Three sharp-tailed sandpipers were observed on the coral flats at low tide.

Prior records: Pacific Ocean Survey Project biologists recorded 3 birds along the causeway between Cooper and Engineer Islands in November 1964 (Clapp and Sibley 1967). No other sightings of this species have been recorded.

Sanderling (Calidrus alba)

Current status: Uncommon migrant. Two sanderlings were observed on the coral flats in the central lagoon.

Prior records: Five sanderlings were observed by Pacific Ocean Survey Project biologists on 28 November 1964 (Clapp and Sibley 1967).

Mallard (Anas platyrhynchos)

Current status: Accidental. None observed during this visit.

Prior records: Munro (1943) cited a letter from a resident on Palmyra who stated a mallard was observed(on or about Octber 1, 1943) (Clapp unpublished).

Pintail (Anas acuta)

Current status: Accidental. None observed during this visit.

Prior records: During World War II, pintails werre recorded on Palmyra Atoll twice. About 5 November, 1942 a mixed flock of ducks arrived on Palmyra. One, wearing a Fish and Wildlife Service band was captured and reported. Upon investigation, it proved to be a drake banded at the Bear River Migratory Bird Refuge in Utah, 82 days before and about 3600 miles away (Lincoln 1943 in Clapp unpublished). In October 1943, a correspondent wrote to George Munro and reported pintails were present on the island (Munro 1943).

Green-winged teal (_Anas crecca_)

Current status: Accidental. None observed during this visit.

Prior records: Pacific Ocean Survey Program biologists collected a single female on Holei Island on 3 April, 1964 (Clapp and Sibley 1967).

European widgeon (_Anas penelope_)

Current status: Accidental. None observed during this visit.

Prior records: Clapp and Sibley (1967) reported that a female was collected on 27 November 1964 on Paradise Island. Munro (1943) quoted his correspondent as having observed ducks that were most likely widgeons, but, lacking a more detailed description, it is unclear which species were present.

American widgeon (_Anas americana_)

Current status: Accidental. None observed during this visit.

Prior records: Clapp and Sibley (1967) reported two American widgeons on Paradise Island on 27 November 1964. See also the discussion of European widgeon above.

Shoveler (_Anas clypeata_)

Current status: Accidental. None observed during this visit.

Prior records: Pacific Ocean Survey Program biologists reported two female and one male shoveler on Holei Island on 3 April 1964, one male on Paradise Island on 6 June 1964 and two females and one male on Paradise Island on 28 November 1964 (Clapp and Sibley 1967).

Laughing gull (_Larus atricilla_)

Current status: Accidental. None observed during this visit.

Prior records: On 5 June 1964, Pacific Ocean Project Survey biologists observed an adult in breeding plumage and two were observed on 28 November 1964 (Clapp and Sibley 1967).

Franklin's gull (Larus pipixcan)

Present status: Accidental. None observed during this visit.

Prior records: Pacific Ocean Survey Project biologists reported 2 Franklin's gulls during their visits (Clapp unpublished). None were recorded previously.

Great crested tern (Sterna bergii)

Present status: Accidental. None observed during this visit.

Prior records: Two geart crested terns were observed flying over Palmyra Atoll in April 1964. No other observations have been documented.

Cattle egret (Bubulcus ibis)

Present status: Accidental. One was observed roosting and was flushed when approached. The bird was in a Tournefortia tree on the southern shore of the southern Fighter Island.

Prior records: None.

Crested mynah (Acridotheres tristis)

Present status: Extinct.

Prior records: Clapp (unpublished) reports that 12 birds were introduced to the atoll in 1950 but that by September 1953 most of these had died. Richardson (1953) observed a single mynah in September 1953.

Mammals

Black rat (Rattus rattus)

Present status: Common. Seldom seen during this visit as we were on the islands only during the day and these rats are nocturnal. Rats of this species were observed on Cooper Island, Eastern Island and Aviation Island. No systematic surveys were conducted.

Prior records: Pacific Ocean Survey Program biologists noted that rats were present during their visits in 1964 and 1965 but did not conduct systematic surveys.

Domestic dog (Canis canis)

Present status: Two domestic dogs (both males) are present on Cooper Island. These dogs are friendly to humans and accompany visitors on the island. Dogs apparently survive by handouts form visitors, and by foraging for fish including sharks and birds and their eggs. Dogs were observed eating bird (sooty tern) eggs on Cooper Island.

Prior records: Three male dogs had been present on Palmyra Atoll since 1979 when the plantation was abandoned. One of the dogs died within the past two years.

Pilot whale (Globicephala scammoni)

Present status: A pod of pilot whales was observed in the entrance channel to the western lagoon during this visit. No systematic surveys were conducted.

Prior records: Pacific Ocean Survey Program biologists observed four pilot whales which were found dead, stranded on the beach on 3 April 1964 (Clapp unpublished).

Bottle-nosed dolphin (Tursiops truncatus)

Present status: Two pods of porposes were observed during this visit indside the entrance channel to the western lagoon. No systematic surveys were conducted.

Amphibians and Reptiles

No surveys of terrestrial reptiles and amphibians were conducted.

Green sea turtle (Chelonia mydas)

Survey methods:

Foraging areas: The area outside of the reef was surveyed in a small skiff from the water surface to determine the number of green sea turtles in this area. The area surveyed was from the wave break on the reef out to about 100 feet. The southern portion of the atoll from Home Island to Barren Island was surveyed on 21 September (Figure 2). The northern portion of the atoll from Strawn Point to Portsmouth Island was surveyed on 24 September. These surveys were conducted in calm sea conditions.

Nesting areas: Beach areas were surveyed for nests on 9/25. The primary habitat for nesting was located on the northwestern portion of Cooper Island where a wide sand beach occurs. Other beaches of Palmyra Atoll are narrow and covered by the sea at high tide. Beach berms in these areas were difficult to survey through the dense vegetation.

Loafing areas: A deep (20-30') hole in the reef flat east of Eastern Island was surveyed for turtles on 21 September.

Present status: Common resident. A total of 40 turtles were observed outside the reef as a result of a direct count. A total of 10 green sea turtles were surveyed in the hole east of Eastern Island via a direct count. A total of 3-5 nests were observed on the atoll via a direct count.

Thirty five green sea turtles were observed in the area on the southern area of the atoll outside the reef between Paradise and Bird Islands. Collerpa sp., an algae, was observed here and it is likely that the turtles were foraging on this algae and that their distribution corresponded to the location of the algal beds. The turtles appeared to be mostly adult size. Five green sea turtles were observed outside the reef on the north of Cooper Island.

The ten green sea turtles surveyed in the hole east of Eastern Island appeared to be loafing.

On 24 September, Chuck Streck, Corps of Engineers Archeologist, reported what appeared to him to be a turtle pit located on the Northwest shore of Cooper Island. On 25 September I located the pit and dug 1 1/2 to 2 ' down into the sand adjacent to the pit and located at least 50 eggs before promptly recovering the eggs with sand. I proceeded to walk the entire length of the beach and found two additional turtle pits and one pit which may have been a turtle nest. I then walked the beach from Paradise to Home Island. This beach is very narrow and is covered with water at high tide.

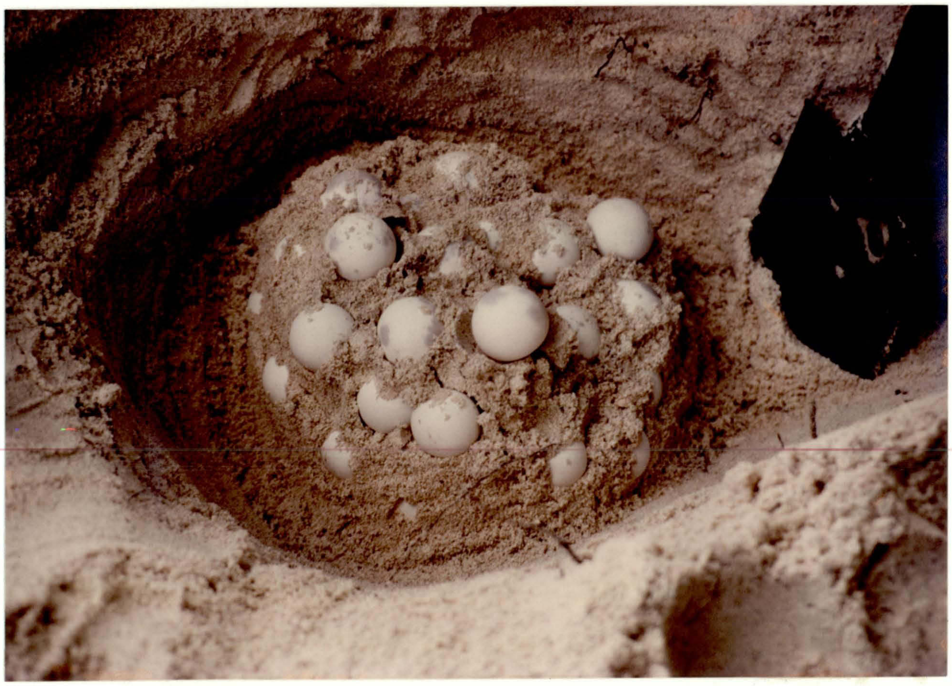
The beach berm is composed of sand overlain with coral rubble. The berm area is covered with dense growths of Tournefortia, Scaevola and Cocos and is very difficult to survey. One possible pit was located on Kaula Island. Turtle pits may occur on this portion of the atoll but were not located due to time/survey constraints. More effort will be required to locate turtle nests on the atoll in the future.

Other observations: During marine surveys (skin diving for about 15-30 minutes on the reef in depths of 15-35 ') green sea turtles were often observed. Undoubtedly, green sea turtle abundance and number of nestings at Palmyra Atoll are greatly underestimated. Foraging turtles are very difficult to observe from a boat without a superstructure for observation and turtle nests were difficult to survey in the dense vegetation on the narrow beaches common to this atoll.

Based on the results of the surveys conducted, Palmyra Atoll is a significant turtle habitat. Further, turtles of Palmyra may be susceptible to predation by the resident rats and dogs and to human harvest by occasional visitors. Due to the remote location of Palmyra Atoll, there is little enforcement of fisheries/endangered species regulations. For example, the relatively large foreign vessel we chartered was at Palmyra Atoll for 9 days, yet it was undetected by enforcement authorities. The nature of the habitat at Plamyra Atoll, especially at the hole in the reef east of Eastern Island, would allow for a readily available harvest of turtles. Anyone landing on theisland could learn of this turtle habitat by reading the "Visitor's Log" in the "Palmyra Yacht Club" on Cooper Island. It may be appropriate to contact the landowner (Ainsley Fullard Leo of Kailua HI) and during the next expedition to Pamyra Atoll, provide him with some information for posting at the "Yacht Club" to inform visitors concerning the status and regulations concerning the turtles.

Prior records: Clapp (unpublished) reported that Pacific Ocean Survey Project personnel reported one small green sea turtle at Palmyra Atoll in early April 1964 and another small turtle off the northwest reef on November 27,1964. Cameron (1923) noted that turtles were few but of gigantic size.

Turtle nesting pit, Cooper Island, Palmyra Atoll. (SF)



Turtle nest, Cooper Island, Palmyra Atoll. (SF)

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The Effect of Potential Cleanup Operations on Wildlife Populations of Palmyra Atoll

Potential areas where hazardous wastes may be removed were identified by Corps of Engineers staff. These sites were located on Cooper Island, Aviation Island, Engineer Island, Quail Island and Paradise Island. During this visit, birds were nesting adjacent to the waste site on Quail Island (red-footed boobies) and under (red-footed boobies), on (white terns) and in close proximity to the towers (brown booby, red-footed booby) on Paradise Island. While no birds were seen nesting in the vicinity of waste sites on Cooper, Aviation or Engineer Islands during this visit, the habitat in the vicinity of the site may provide for nesting of a variety of species at other times of year.

Due to the location of waste sites in areas where nesting of migratory birds occurs or may occur, it is likely that migratory birds, nests, and/or young may be lost during a clean-up operation due to disturbance or direct destruction. The numbers of birds that may be affected may be minimized at the site with proper consideration. Nevertheless, some loss may be unavoidable. These losses are not expected to be significant and would not affect the status of the individual species of migratory birds at Palmyra Atoll. In the long-term, the clean-up operation may be beneficial as leaking barrels of waste and falling towers could affect birds and their habitat at Palmyra in the future.

As there will be losses of birds during the clean-up operation, a Federal Migratory Bird Permit for the take of a specific number of birds, eggs or nests of the species involved will be required. A biologist would be needed to assess the extent of the take at the time of the clean-up for issuance of the permit. Population estimates from other periods would not be acceptable due to the variation in bird chronology and habitat usage.

Because of the significance of the Palmyra Atoll wildlife populations, it is recommended that a biologist assist with the clean-up operation to provide suggestions to minimize effects on the migratory birds of the atoll and, perhaps, to move nests or chicks where this is feasible. In addition, the biologist could provide accurate numbers for the required permit report.

With the provision of a biologist for the above purposes during the clean-up operation, a clean-up of waste sites on Palmyra Atoll would be considered as beneficial to the wildlife resources there.

Paradise Island, Palmyra Atoll. (SF)

Paradise Island, White tern nest in tower, Palmyra Atoll. (SF)

Palmyra Atoll as a Wildlife Habitat

Palmyra Atoll is a unique ecosystem that is one of the most significant migratory bird and threatened green sea turtle habitats in the world. It is the only low, wet, forested atoll with a relatively large land mass in the United States. It has national and international significance as a habitat for several species (Garnett 1984).

Palmyra Atoll supports the largest red-footed booby colony in the Central Pacific (King 1973) and one of the largest brown booby and black noddy colonies. It also supports significant sooty tern colonies. Palmyra is an important habitat for migratory shorebirds including the potentially rare bristle-thighed curlew. Palmyra may be a significant stopover area for curlews as they migrate between the breeding areas in Alaska and the wintering grounds on islands in the Central and South Pacific. The intertidal areas of Palmyra are important habitats for shorebirds.

Palmyra Atoll supports a significant population of green sea turtles. The reef provides foraging habitat for these turtles. Nesting may be significant as well. Further surveys are required to determine the use of this atoll by nesting turtles.

Palmyra is the only wet, forested atoll with a significant land area in the United States. Individual species of plants on Palmyra are not threatened or endangered. However, plant communities on Palmyra, such as the extensive *Pisonia* forest, are rarely found on the inhabited islands of the Pacific.

Palmyra Atoll may be threatened by development in the near future. The Strategic Defense Intiative requires a United States based equatorial launch site and Palmyra has been proposed for study as such a site. (U.S. Air Force and Hughes Aircraft personnel are travelling to the site during the winter of 1987/1988 and discussions have been in progress concerning purchase of the island for this purpose.) If such a proposal was realized, the influx of personnel, construction, dredging and operation of the facility would undoubtedly have major effects on the wildlife populations of the atoll. If the wildlife populations of Palmyra are to be maintained, the existing atoll must be maintained in its present undisturbed condition. If activities which alter the habitat and/or result in use of the atoll by humans are proposed, significant restriction and/or mitigation of these activities will be required to ensure the significant wildlife populations on Palmyra are maintained.

March 3, 1849

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P. O. BOX 50167
HONOLULU, HAWAII 96850

November 18, 1987

Helene Takemoto .
U.S. Army Engineer Divison, Pacific Ocean
Corps of Engineers (COE POD-ED-P)
Building 230
Ft. Shafter, HI 96858-5440

Dear Helene:

In accordance with our agreement for services E87870056 dated August 21, 1987, I submit the enclosed report in fulfillment of the Scope of Work. Thank you for the opportunity to provide this information.

Sincerely yours,

Stewart I. Fefer

Stewart I. Fefer
Refuge Complex Manager
Hawaiian Wetlands & Remote
Islands NWRs

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United States Department of the Interior

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HONOLULU, HAWAII 96850

IN REPLY REFER TO:

28 Jan 1988

James Maragos, Chief
Environmental Resource Section
Planning Branch
U.S. Army Corps of Engineers
Pacific Ocean Division (CEPODED-PV)
Building T-1
Fort Shafter, Hawaii 96858-5440

Dear Jim:

The enclosed report is submitted in accordance with our agreement for services E87870056, dated August 21, 1987. Thanks for the opportunity to participate in a great trip to a fascinating atoll.

Sincerely yours,

Derral R. Herbst
Botanist
Office of Environmental Services

Flora and Vegetation of Palmyra Atoll

On September 18-25, 1987, a survey of the flora and vegetation of Palmyra Atoll was conducted for the U.S. Army Corps of Engineers as part of their program to locate and sample potential contaminants left from the World War II military occupation of the islands. The primary purpose of the botanical survey was to develop a species list of plants on the atoll, to assess the vegetation of the area, and to determine the impact of a possible contaminant cleanup operation on the flora and vegetation of the islands. The trip itinerary, a list of participating personnel, and a general description of the atoll is provided in the trip report by Stewart Fefer, and will not be repeated here.

Flora

The vascular flora of Palmyra Atoll comprises 103 species. Nineteen are considered native and are mostly common, widespread strand plants. Another 46 are adventive or naturalized, while the remaining 38 are vegetables or ornamentals purposely introduced (Table 1). None of the vegetables and approximately half of the ornamentals reported from the islands have persisted. This is to be expected as many domesticated plants cannot exist without human care and maintenance, while others may have been killed by seawater during tropical storms. A severe storm did extensive damage to the islands in January, 1958. Nearly three feet of seawater is reported to have flooded the main runway on Cooper Island; buildings were collapsed, and parts of islands were washed away (3). Dawson, who was on Palmyra shortly after the storm, believed that many of the earlier plantings had been washed away or killed by saltwater during the storm, leaving only those resistant to typhoon conditions (3).

In addition to the vascular plants, 88 species and two varieties of marine and two species of terrestrial algae, three mosses, seven lichens, and four species of fungi have been reported from Palmyra. These are not included in this report but are listed by Rock (10) and Dawson (3). An additional species of lichen, Anaptychia isidiphora (Nyl.) Vain (Herbst s.n., HAW) was collected during this trip.

Seventeen species of vascular plants previously unreported from Palmyra were found; nine were vouchered, seven, all cultivated species, are based on observational records (Table 2). Four of the new records, Premna, Hernandia, Caesalpinia, and Entada, probably can be considered native to Palmyra if they become established as all arrived by natural means (i.e. without the intervention of man). Three have seeds adapted for water dispersal and probably floated in from other islands. The fourth, *Premna*, has a small fleshy fruit and is bird dispersed. An annotated checklist of the vascular plants of Palmyra is attached as Appendix 1. Table 3 lists the individuals who have collected vascular plants on Palmyra, and the date of their visit.

Vegetation

Several accounts of the vegetation of Palmyra Atoll have been published. The earliest was that by Rock (10), who spent 16 days on the islands in 1913. He later published a popular account of the trip (11) which included generalized overviews of the vegetational aspects of the islands. Christophersen (2), in his publication on the vegetation of Pacific equatorial islands, gives general features of the vegetation of Palmyra while referring his readers to the Rock publication for greater detail. He then describes the soils of the islands in relation to their vegetation. A useful book on the ecology of atolls is that by Wiens (14) who discusses the means by which plants are transported to oceanic atolls, their distribution among the atolls, and the associations they form. Palmyra is included in his discussions.

The vegetation of Palmyra remains much as Dawson (3) described it, with the changes one would expect to occur over the twenty years since his stay. The main changes have occurred in the highly disturbed areas, the causeways, for example, have become more overgrown and are now virtually impassable due to the dense growth of trees and shrubs. Barren Island has become larger and more heavily vegetated, and the borders of the runway on Cooper Island, which were covered with a low, sparse growth of weeds as *Pluchea*, *Conyza*, *Fimbristylis*, *Chamaesyce*, and *Stachytarpheta*, now are vegetated more by native shrubs and herbs as *Lepturus*, *Scaevola*, and *Tournefortia*.

Three main vegetational associations were observed on the islands. These are the coconut forest, the *Pisonia* forest, and the *Scaevola* - *Tournefortia* vegetation types. Other minor vegetation types occur on Palmyra and are mentioned below. Most are so small they would not be plotted on a conventional vegetation map.

Coconut forest vegetation type.

The coconut forest is the most common vegetation type on Palmyra. There are two subtypes: the coconut - Asplenium and the coconut - Phymatosorus associations. Both of these vegetation types consist of dense groves of coconut with an occasional Tournefortia, Pisonia, or other species of trees. Sparse growths of Lepturus or Laportea can be found where the canopy is open. In areas where the canopy is more closed, the groundcover is a dense growth of Asplenium or Phymatosorus, with fronds often five or six feet tall. Asplenium tends to favor a more closed canopy, perhaps because it usually starts as an epiphyte on rotting coconut husks or fallen logs, and a dense canopy maintains the wetter habitat required for its establishment. Occasionally, as on Tanager Island, for example, the coconut forest will have a groundcover composed primarily of a litter of fronds and fallen nuts with a sparse growth of ferns. The best coconut forests are found on the original islands. The roadways constructed in 1941 and 1942 joining all the major islands, are vegetated by the coconut forest association in some places, but the vegetation is not as well developed as that on the original islands.

Scaevola - Tournefortia vegetation type.

The next most common vegetation type on Palmyra is the Scaevola - Tournefortia association. Tournefortia trees and Scaevola shrubs are the dominant species in this vegetation type. Other, less common trees include Pandanus, coconut, and Pisonia. In more open areas, as along the causeways, the herb Laportea and the grass Lepturus may be common components of the vegetation; other elements may include the vine Ipomoea and occasionally a Pluchea indica shrub. This vegetation type forms the outer margins of vegetation on nearly all the islands, and in some instances, as on Holei Island, may extend into the interior. Some of the smaller islands as Home 4, or islands such as Sand Island, which were cleared during the 1940's, also support this vegetation type.

Pisonia forest vegetation type.

The third most common vegetation type on Palmyra is the Pisonia forest. These are magnificent stands of trees 70 or 80 ft. tall. Usually they have no other species of trees growing with them, except, perhaps, just at the edges of the grove. The groundcover is usually sparse or lacking, but some epiphytic ferns may be present. The Pisonia forest on Eastern Island is an exception in that it has a dense groundcover of Phymatosorus fern. Prior to the prehistoric discovery of the islands by Polynesians, the vegetation probably was predominantly *Pisonia* forests, mostly fringed by the *Scaevola* - *Tournefortia* association. Undoubtedly much of the forest was cleared by the early Polynesians so that coconut groves could be established, and, to a certain extent, probably also to provide firewood.

Lepturus grassland vegetation type.

The best example of this vegetation type occurs along the runway on Cooper Island. The main constituent of this association is the grass *Lepturus repens*, with an occasional young *Tournefortia* or *Scaevola* shrub. If undisturbed, the grassland probably would eventually be replaced by the *Scaevola* - *Tournefortia* association, which subsequently would be displaced by a *Pisonia* or coconut forest.

Pandanus thicket vegetation type.

These are small, dense stands of *Pandanus*, sometimes with a sparse growth of the fern *Phymatosorus* as a groundcover. Examples can be found on Holei, Eastern, Cooper, and other Islands.

Hibiscus thicket vegetation type.

Dense, local stands of hau can be found on several islands, but perhaps most commonly on Cooper and Menge. Depending on the density of the crown, the groundcover may consist of a dense growth of *Phymatosorus* to a very sparse covering of fern or weeds. The leaves of many individuals were chloratic.

Scaevola association vegetation type.

This vegetation type is composed of an open stand of *Scaevola sericea* with some coconut and *Tournefortia*. It was seen only on Barren Island and probably represents a very early successional stage.

Alien communities.

These man-induced communities of exotic or alien species are on Palmyra, usually intermixed with a scattering of native plants. They occur on islands disturbed or altered by man, and today are restricted mostly to Menge and parts of Cooper and Strawn Islands. Small, local, nearly pure stands of Ipomoea, Casuarina, or Tournefortia probably are best included here as they were found primarily in areas which had previously been disturbed by man.

Disposal sites

Disposal sites.

Site 1: This is a barrel dump located on the lagoon-side beach of Quail Island. The vegetation consists primarily of an open stand of *Scaevola sericea* and *Hibiscus tiliaceus*, covered with *Ipomoea macrantha*.

Site 2: Site 2 is a transformer in a concrete building beneath the radio towers on Paradise Island. The vegetation of this area has reverted to an open coconut - *Phymatosorus* association.

Site 3: Site three is the hospital building on Engineer Island. The vegetation on the lagoon-side is a coconut - *Phymatosorus* association, changing to a coconut forest with only a litter of fallen nuts and fronds as a groundcover on the ocean-side of the building. The hospital and the trunks of some adjacent trees are densely covered by taro vines.

Site 4: This site is a munitions bunker on the northeastern end of Cooper Island. The bunker is located in a coconut - *Phymatosorus* vegetation association.

Site 5: These are the four mounded diesel and bunker c crude fuel tanks located on the lagoon-side of Menge and Cooper Islands. The mounds are vegetated with coconuts, *Hibiscus tiliaceus*, and *Scaevola* with a groundcover of sword or maile-scented ferns.

Site 6: Site 6 is a barrel dump on Menge Island. The area is vegetated with herbs and low-growing shrubs as *Stachytarpheta*, *Fimbristylis*, and *Pluchea* x*fosbergii* with an occasional *Leucaena* or *Terminalia* tree.

Site 7: Three fuel tanks on Menge Island. They are located in a coconut - *Phymatosorus* association.

Site 8: This site is a raised platform with three transformers on the northern side of Cooper Island. The site is open with a dense groundcover of *Phymatosorus* fern. It is bordered by dense stands of coconut, *Hibiscus*, *Scaevola*, and *Pandanus* with a few *Terminalia* and *Tournefortia* trees.

The vegetation of the eight disposal sites sampled is composed of a mixture of native and introduced, naturalized species. The native plants present on the sites are common throughout the atoll and disturbance of the sites would not significantly impact the total population of the species on Palmyra. The approximate location of the sites is plotted on Map 1.

Table 1: Status of species

	Native	Adventive or naturalized	Cultivated or persisting	TOTAL
Pteridophyta	3 (60%)	1 (20%)	1 (20%)	5
Gymnospermae	0 (0%)	0 (0%)	1 (100%)	1
Monocotyledoneae	2 (8%)	16 (64%)	7 (28%)	25
Dicotyledoneae	14 (20%)	29 (40%)	29 (40%)	72
TOTAL	19 (18%)	46 (45%)	38 (37%)	103

Table 2. Plants not previously reported from Palmyra Atoll

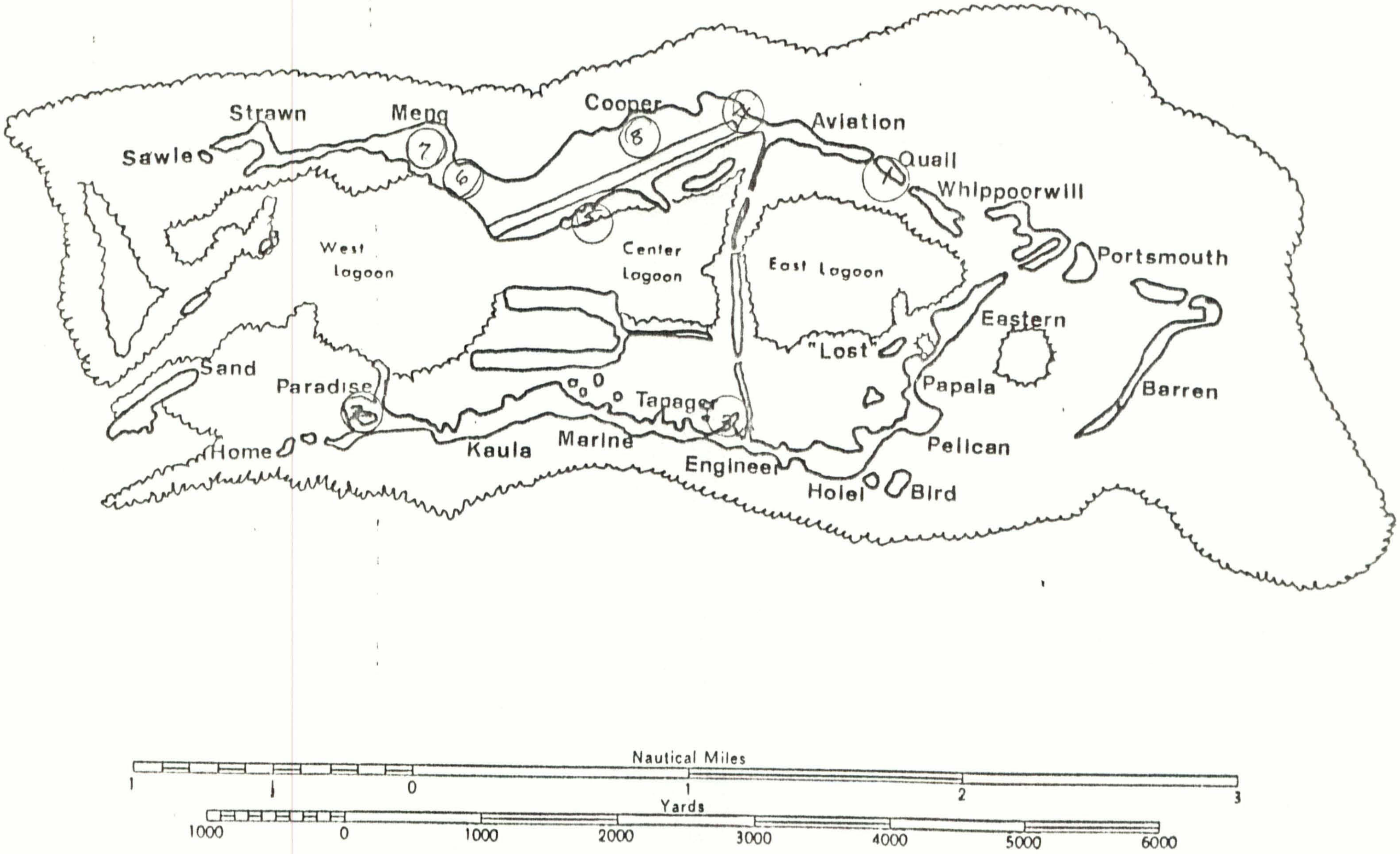
Taxon*	Voucher	Observation
Ophioglossum petiolatum Hook.	Herbst 8835	
Ananas comosus (L.) Merr.		X
Cyperus brevifolius (Rottb.) Hassk.	Herbst 8872	
Aloe vera L.		X
Spathoglottis plicata Blume	Herbst 8865	
Digitaria pacifica Stapf	Herbst 8844	
Digitaria setigera Roth	Herbst 8860	
Annona sp.		X
Plumeria sp.		X
Caesalpinia major (Medik.) Dandy and Exell	Herbst 8870	
Entada phaseoloides (Stickm.) Merr.	Herbst 8853	
Hernandia sonora L.	Herbst 8868	
Persea americana Mill		X
Hibiscus rosa-sinensis L.		X
Sida rhombifolia L.	Herbst 8838	
Syzygium malaccense (L.) Merr. and Perry		X
Premna obtusifolia R. Br.	Herbst 8864	

*The first set of all Herbst collections are deposited in the Herbarium Pacificum, Bishop Museum (BISH); a second set, missing only _Suriana_, was sent to the Smithsonian Institution (US).

Table 3. Collectors of Palmyra Atoll vascular plants.

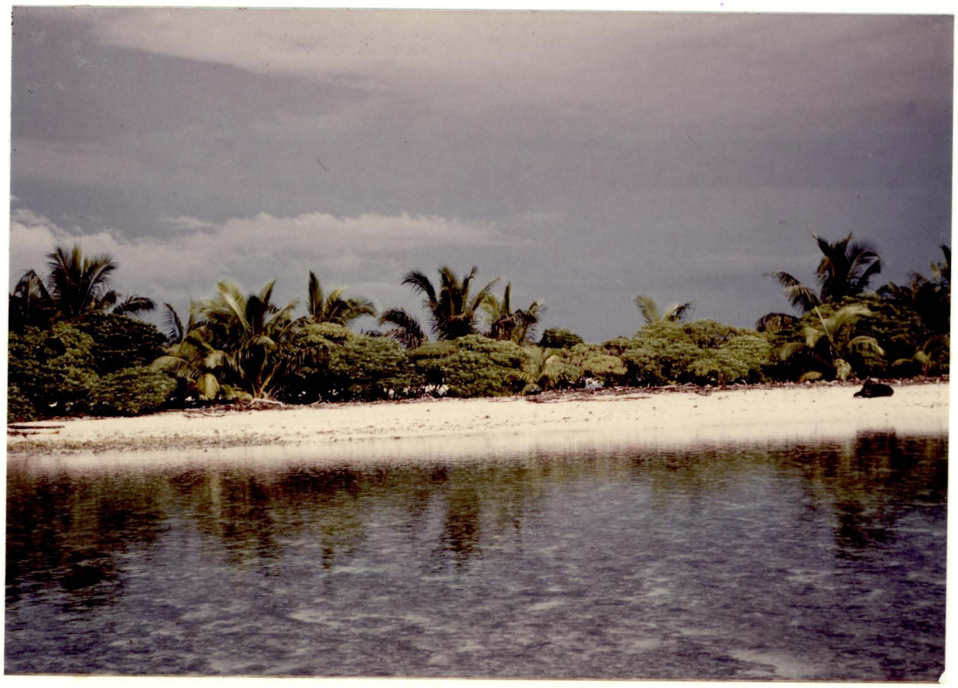
Name	Date of collections
Streets, Thomas H.	12-27 December 1873
Rock, Joseph F. C.	12-28 July 1913
Cooke, Charles Montague, Jr.	12-28 July 1913
Cooper, Henry E.	12-28 July 1913, March 1914
Bryan, Edwin H., Jr.	23 March 1935, 11-12 August 1938
Judd, Albert F.	13 June 1935
Mitchell, Donald D.	13 June 1935
Brown, Ashley	17 October 1939
Hill, Margaret	October 1949, December 1949
Dawson, E. Yale	15-21 October 1958
Moeller, Henry S.	28 December 1959-3 January 1960
Long, Charles Robert	6-7 June 1964, 27-28 November 1964
Herbst, Derral R.	18-25 September 1987

Map 1: Disposal sites sampled

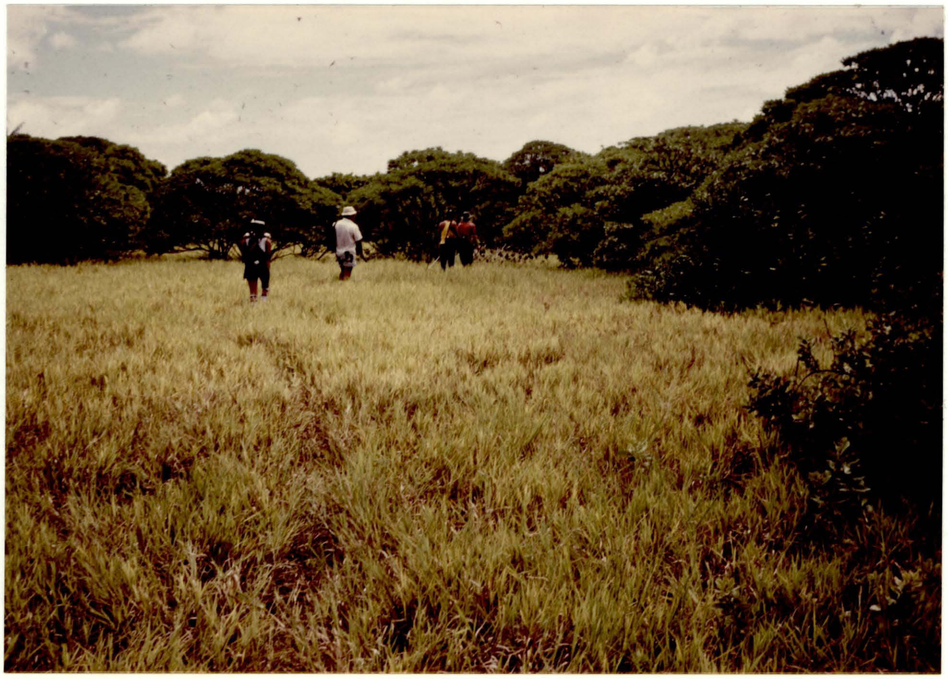


Coconut - *Asplenium* vegetation type.

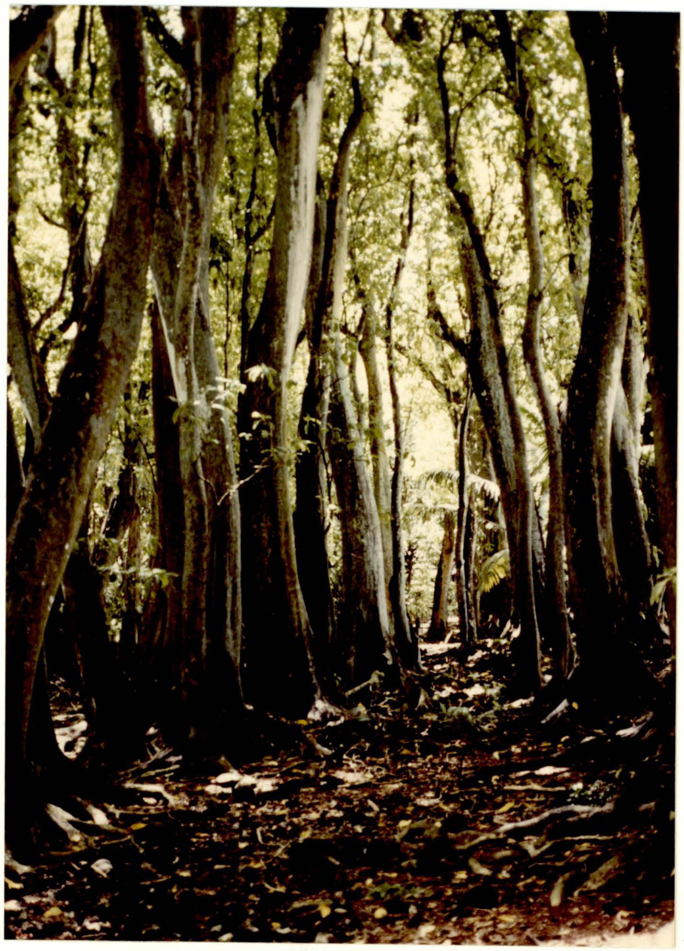
Coconut - *Phymatosorus* vegetation type.



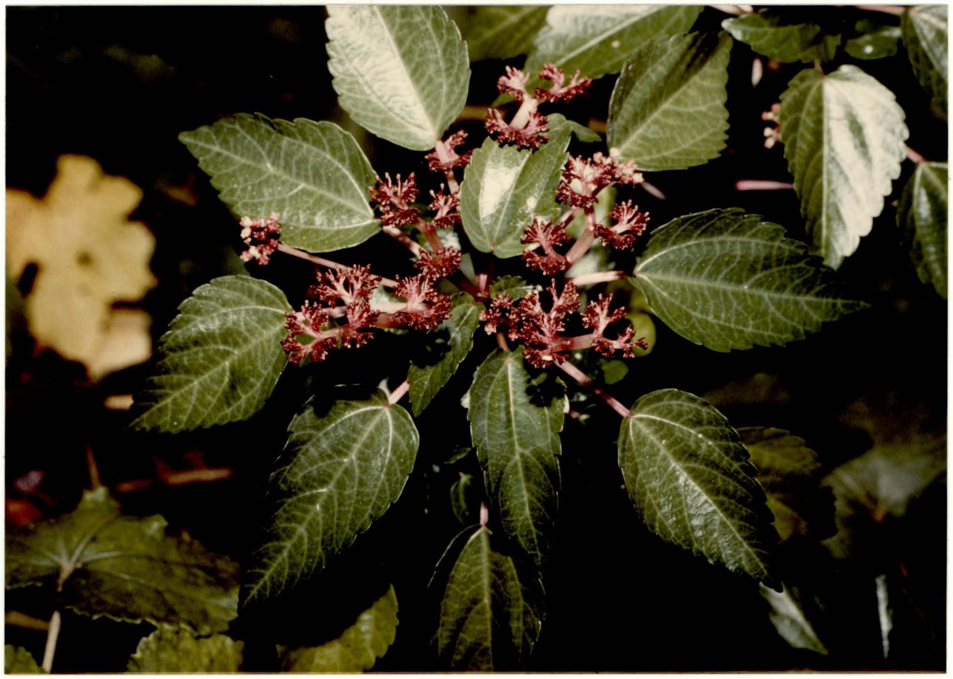
Scaevola - Tournefortia vegetation type.



Lepturus grassland vegetation type.

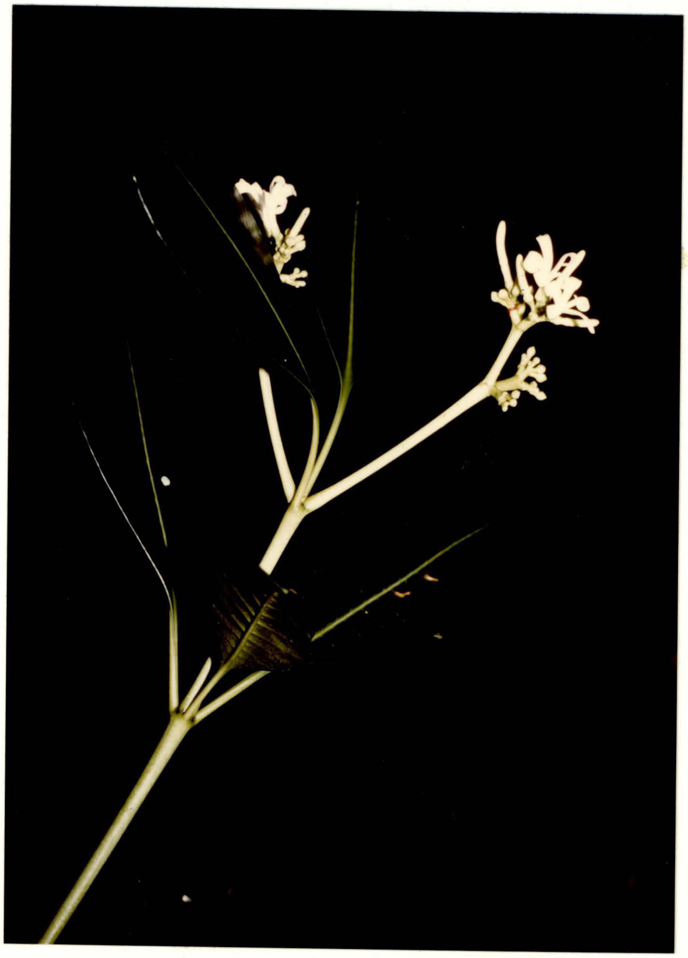


Pisonia forest vegetation type.



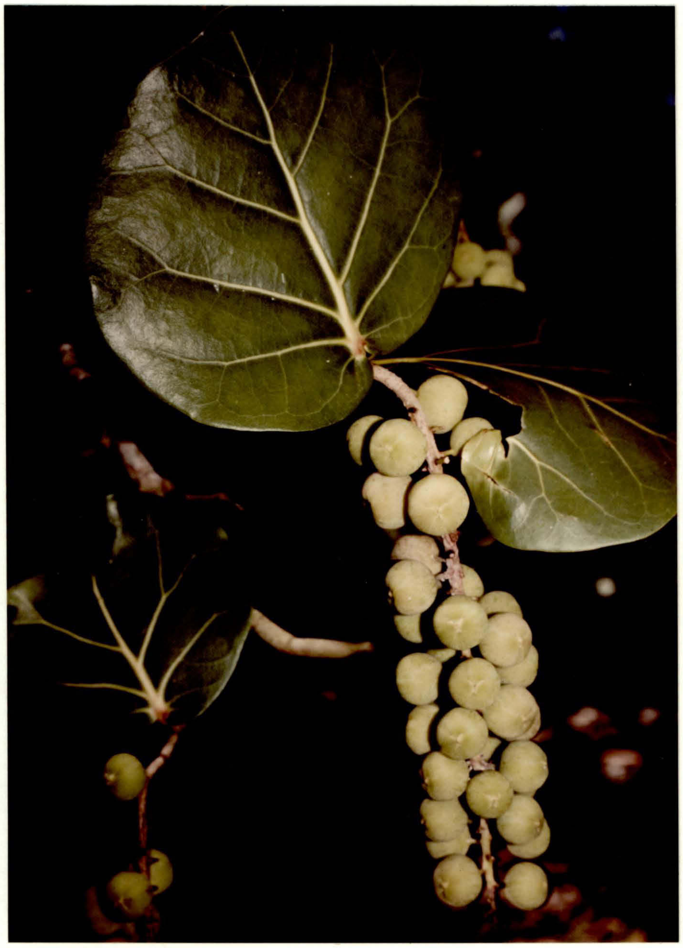
Laportea ruderalis

A common component of the Scaevola - Tournefortia vegetation type.



Neisosperma oppositifolia

A native tree found only near the western end of Holei Island.



Coccoloba uvifera

Introduced in 1936; now naturalized on seven islands.

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APPENDIX 1: Annotated checklist of the vascular plants of Palmyra Atoll

The following checklist was compiled from reports in the literature, from specimens in the herbarium of the Bernice P. Bishop Museum, and from collections and observations made by Herbst between the 18th and 25th of September, 1987. The entries are arranged alphabetically and include the scientific name, the common name, herbarium specimens, and general abundance, status, and distributional notes. Seventy seven percent (198 collections) of the specimens cited were located at the Bishop Museum, and their determinations were verified. The common names listed are those used in Hawai'i. Plants believed to have been accidentally or intentionally introduced to Palmyra by man are preceded by an asterisk.

PTERIDOPHYTA

ASPLENIACEAE

Asplenium nidus L. (bird's nest fern)

Streets, s.n.; Rock 10280, s.n.; Cooke s.n.; Bryan 879, 1402; Long 1776a, 1790; Herbst 8828.

One of the most common groundcovers; in the interior of many of the islands, forming dense stands with plants often nearly six feet tall. In 1987, contrary to previous reports, it was rarely seen as an epiphyte.

NEPHROLEPIDACEAE

*Nephrolepis hirsutula (Forsk. f.) Presl. (sword fern)

Dawson 19806; Long 1798, 2852; Herbst 8854.

First collected by Dawson in 1958, who recorded it from "Menge Island; also abundant on Cooper Island." It presently is very abundant on these two islands.

OPHIOGLOSSACEAE

*Ophioglossum petiolata Hook. (Adder's tongue fern)

Herbst 8835.

New record for Palmyra. The plant was growing as a weed in a pot of Aloe vera L. on Menge Island.

POLYPODIACEAE

Phymatosorus scolopendria (Burm.) Pichi Sermolii (maile-scented fern)

Streets, s.n.; Rock and Cooke 10281; Judd and Mitchell s.n.; Brown s.n.; Long 1789, 2838; Herbst 8850.

According to Merrill (9), the specimen in the National Herbarium collected by Streets on Palmyra in December, 1873, and labeled Polypodium aureum Sw. is actually this species. Rock (10) states that this fern is a common epiphyte on Cooper and Holei Islands and is terrestrial on some of the other islands, but never growing as large as the epiphytic form. During this survey it was the most common groundcover encountered, forming dense stands of large plants.

PSILOTACEAE

Psilotum nudum (L.) Beauv. (moa)

Dawson 19845a; Long 2840; Herbst 8837.

Most commonly growing as an epiphyte at the base of coconut trees. Documented only from Menge Island, but observed also on Tanager.

GYMNOSPERMAE

ARAUCARIACEAE

*Araucaria sp. (Norfolk Island pine)

A single tree was planted by the buildings at the head of the seaplane ramp. It is about 30 ft. tall, and probably is the same tree reported by Dawson (3).

MONOCOTYLEDONEAE

ARACEAE

**Epipremnum pinnatum* (L.) Engl. (taro vine)

Dawson 19845; Long 1794, 2854; Herbst 8827.

Introduced as an ornamental, now well established and spreading vegetatively on Kaula and Engineer Islands. It is the cultivar ‘aureum,’ a variegated form.

ARECACEAE

**Cocos nucifera* L. (coconut)

Palmyra has been heavily forested with coconuts since the western discovery of the Atoll in 1802. The groves have increased in size through sporadic plantings, which have occurred at least as late as 1951, and through natural regeneration. A dubious taxon of coconut, f. *palmyrensis* was described by Beccari (10), based on its somewhat larger fruits. It was considered endemic to Palmyra.

BROMELIACEAE

**Ananas comosus* (L.) Merr. (pineapple)

A single cultivated plant in a container was observed on Menge Island in 1987. Not previously reported from Palmyra.

CYPERACEAE

**Cyperus brevifolius* (Rottb.) Hassk.

Herbst 8872.

Growing in bare soil at the edge of a coconut grove, Cooper Island. Rare. New record for Palmyra.

**Cyperus javanicus* Houtt. (’ahu’awa)

Dawson 19840; Long 2860.

Collected on Aviation Island, where it was uncommon, and also observed by Dawson (3) on Cooper Island.

MONOCOTYLEDONEAE - continued

CYPERACEAE - continued

*_Cyperus polystachyos_ Rottb.

Hill 19; Dawson 19811; Long 1781, 2859.

Apparently localized on Menge and Cooper Islands. Not seen in 1987.

*_Fimbristylis cymosa_ R. Br.

Hill s.n; Dawson 19803; Long 1771, 1772, 1784, 1793, 2844; Herbst 8851, 8874.

Common in disturbed areas throughout the atoll, particularly around the buildings on Menge Island.

LILIACEAE

*_Allium cepa_ L. (onion)

Dawson (3) reports that onions were grown in the vegetable gardens of Civil Aeronautics Authority personnel during the three years (1947-1950) that they were stationed on Palmyra.

*_Asparagus_ sp. (asparagus fern)

Included in a list of ornamentals present on Menge Island by Dawson (3). It probably has not persisted.

*_Aloe vera_ L. (aloe)

A single cultivated plant in a container was observed on Menge Island in 1987. New record for Palmyra.

*_Cordyline fruticosa_ (L.) Chev. (ti)

Reported by Dawson (3) as an ornamental on Menge Island. It was not seen in 1987.

*_Sansevieria trifasciata_ Prain (bowstring hemp)

Cultivated in a pot on Menge Island, 1987. Also reported by Dawson (3) as persisting as a cultivated plant on Menge Island.

MONOCOTYLEDONEAE - continued

MUSACEAE

**Musa* x*paradisiaca* L. (banana)

Three young plants were growing by the building at the head of the seaplane ramp, Menge Island in 1987. Records indicate that bananas have been planted on Palmyra in the past, but have not persisted.

ORCHIDACEAE

**Spathoglottis plicata* Blume (ground orchid)

Herbst 8865.

A small local population was found on the western end of Menge Island, growing in a dense *Lepturus* - *Phymatosorus* association. New record for Palmyra.

PANDANACEAE

Pandanus fischerianus Mart. var. *bryanii* B.C. Stone (hala)

Bryan 880, 1403.

This variety is based upon a collection made on a "low sand islet" on Palmyra Atoll by E.H. Bryan in 1935. It also has been collected on Washington Island.

Pandanus fischerianus Mart. var. *cooperi* (Mart.) B.C. Stone (hala)

Cooper s.n.

Martelli first described this taxon as *P. pulposus* var. *cooperi* from material collected by H.E. Cooper at an unspecified locality on Palmyra in 1914. After studying the *Pandanus* of the Marshall Islands, Stone (12) concluded that this taxon probably was better placed as a variety of *P. fischerianus*.

PANDANACEAE - continued

Pandanus _fischerianus_ Mart. var. _rockii_ (Mart.) B.C. Stone (hala)

Rock, s.n; Judd and Mitchell, s.n.; Moeller, s.n.

Martelli described _P_. _rockii_ from a specimen collected by J.F. Rock on Holei Island in 1913. Stone (12), however, considers it a variety of _P_. _fischerianus_, and it is treated as such here. Fosberg (5) and Dawson (3) regard the above three varieties, perhaps correctly, as trivial forms of the widespread _P_. _tectorius_ Park.

POACEAE

*_Cenchrus_ _echinatus_ L. (sandbur)

Hill 12.

Collected once on Menge Island in 1949 and apparently did not become established. The specimen originally was identified as var. _hillebrandianus_ (Hitch.) F. Br. a trivial taxon characterized by its pilose foliage.

*_Chloris_ _inflata_ Link (inflated fingergrass)

Hill 14.

Known from a single collection made on Menge Island in 1949.

*_Digitaria_ _pacifica_ Stapf

Herbst 8844.

An erect, coarse grass found growing along the runway on Cooper Island. It is fairly common on Christmas Island and may have inadvertently been brought from there along with passengers or cargo. New to Palmyra.

*_Digitaria_ _setigera_ Roth

Herbst 8860.

Growing on a concrete floor-slab near the seaplane ramp, Menge Island. New to Palmyra.

MONOCOTYLEDONEAE - continued

POACEAE - continued

*_Eleusine_ _indica_ (L.) Gaertn. (goosegrass)

Hill s.n.; Dawson 19853, 19854.

Collected twice, once each on Cooper and Menge Islands. Was not seen in 1964 and 1987, and may no longer persist on the islands.

Lepturus _repens_ R. Br. var. _palmyrensis_ F. Br.

Rock 10276; Cooke s.n.; Judd and Mitchell 14b; Bryan 881, 1396; Dawson 19843; Long 1783, 1800, 2841, 2858, 2861, 2867; Herbst 8839.

This is the only member of the grass family native to Palmyra, and is common in open, exposed places. It forms extensive stands on Cooper and Menge Islands, and also has been collected from Kaula Island and the causeway. In 1987, small patches were observed on nearly all of the islands. Fosberg (4) states that this variety is endemic to Palmyra, but is closely related to taxa found on Malden and Christmas Islands, and Pokak and Wake Atolls. The genus is badly in need of further study. Listed as _Monerma_ _repens_ (R. Br.) Beauv. in earlier literature.

*_Paspalum_ _fimbriatum_ Kunth (Columbia grass)

Dawson 19852; Long 1817, 1821.

According to Long (8), this species was ... "highly localized on Cooper Island."

*_Paspalum_ _orbiculare_ Forst. f. (ricegrass)

Dawson 19811a; Long 1817b; Herbst 8856.

Presently naturalized only on Menge and perhaps Cooper Islands.

*_Sporobolus_ _indicus_ (L.) R. Br. (West Indian dropseed)

Dawson 19832; Long 1782, 2857; Herbst 8849.

Naturalized in open, disturbed areas on Menge and Cooper Islands. Listed in earlier publications as _S_. _poiretti_ (R. & S.) Hitchc., a synonym of _S_. _indicus_.

MONOCOTYLEDONEAE - continued

POACEAE - continued

**Zea mays* L. (corn)

Rock (1916) reports that Capt. Zenas Bent of the Schooner Louisa planted corn on Palmyra in 1862. It has not persisted.

DICOTYLEDONAE

ACANTHACEAE

**Graptophyllum pictum* (L.) Griff. (caricature plant)

Dawson 19849.

"Menge Island, local." A cultivated plant probably no longer on the island.

**Hemigraphis reptans* (Forst. f.) T. Anderson

Dawson 19846; Herbst 8832.

In Dawson's publication (3), this plant is incorrectly listed as *Blechum brownei* Juss. (inadvertently as *Blechnum*, a genus of ferns). In 1987, it was persisting or sparingly naturalized around the two-story, wooden barracks building, Menge Island.

**Pseuderanthemum carruthersii* (Seem.) Guill.

Dawson 19850.

Reported by Dawson (3) as ... "Menge Island, local." Probably a cultivated plant no longer on the island.

AMARANTHACEAE

Dawson (3) states that ... "Several alien plants persist [on Menge Island] as plantings, some in their original nursery tins, but do not appear capable of reproduction. These include ... an amaranth ...." The identity and status of this plant is unknown, but it probably is no longer on the island.

ANACARDIACEAE

*Mangifera indica L. (mango)

Observed by Herbst in 1987. A single young tree, about five feet tall, had been planted near the head of the seaplane ramp, Menge Island. Kenner (7) reports that on 23 July 1936 ... "Two parties were sent to the islands for the purpose of planting seeds and plants at the request of Mr. Fullard-Leo of Honolulu, owner of the islands of the Group. Half of the plants were planted on Home Island, the rest on Cooper Island." The plants included four grafted Pirie (?) mangoes and six mango seedlings. Fullard-Leo (6) stated that ... "The writer and other visitors over a period of fifty years, had planted melons, beans, bananas, papaia, mango, tomatoes, and other vegetables and fruits." None of these plantings appear to have persisted.

*Anacardium occidentale L. (cashew)

The list of plants in the Kenner (7) report included six cashew nuts. There is no other mention of them in the literature, and they are not extant today.

ANNONACEAE

*Annona sp.

A single young tree was observed by Herbst in 1987. It was about four feet tall, and had been planted at the head of the seaplane ramp. It probably is A. muricata L., the soursop. No member of this family had previously been reported from Palmyra.

APOCYNACEAE

Neisosperma oppositifolia (Lam.) Fost. & Sachet

Rock and Cooke 10279; Hill 3; Dawson 19847; Herbst 8852.

A small population of about eight trees is located near the western end of Holei Island. This is the same population discovered by Rock in 1913, but, according to Rock (10), at that time formed a dense forest of trees up to 50 ft. tall. It apparently was observed but not collected by Long (8) in 1964. This species is cited as Ochrosia oppositifolia (Lam.) K. Schum. in earlier literature.

DICOTYLEDONAE - continued

APOCYNACEAE - continued

**Plumeria* sp. (plumeria)

Two cultivated young trees, about four feet tall, were observed by Herbst in 1987 at the head of the seaplane ramp. They probably are *P. rubra* L. f. *acutifolia* (Poir.) Woodson. First report of the family from Palmyra.

ARALIACEAE

**Nothopanax scutellarum* (Burm. f.) Merr. (panax)

Long 2855.

An ornamental shrub not seen in 1987.

**Polyscias balfouriana* (Sander) Bailey

Long 2854.

Known only from this collection. It is an ornamental shrub and probably was planted around the buildings on Menge Island. Not observed in 1987.

ASTERACEAE

**Conyza bonariensis* (L.) Cronq. (hairy borseweed)

Hill 9, 10, 13; Dawson 19804; Herbst 8819.

A common weed of open, disturbed areas on Menge Island. Listed as *Erigeron bonariensis* L. in earlier literature on Palmyra plants; misidentified as *E. canadensis* L. by Dawson (3).

**Emilia sonchifolia* (L.) DC. (pualele)

Dawson 19836.

Collected only by Dawson in 1959 who lists it from Menge, Cooper, and Aviation Islands; not seen by Long or Herbst.

ASTERACEAE - continued

*Erectites hieracifolia (L.) Raf. (fireweed)

Hill 20.

This weed was listed as E. valerianaefolia (Wolf) DC. by Dawson (3). Fosberg later redetermined it as E. hieracifolia.

*Pluchea xfosbergii Cooperider & Galang

Hill 8, 21; Dawson 19805, 19841; Long 1760, 1767, 1786, 1804, 2835; Herbst 8823.

This is a natural hybrid between P. indica and P. symphytifolia and occurs whenever the two grow together. The Hill collection determined as P. indica or P. odorata on the Dawson (3) list, belongs here.

*Pluchea indica (L.) Less. (Indian pluchea)

Bryan s.n.; Dawson 19842; Long 1773, 1799, 1823, 2842; Herbst 8829, 8862.

Observed on Menge and Cooper Islands and on the causeway near Aviation Island, not common.

*Pluchea symphytifolia (Mill.) Gillis (sour bush)

Hill 8; Dawson 19842; Long 1761, 1763; Herbst 8836, 8861.

This is the P. odorata (L.) Cass. of earlier lists. In 1987 members of this genus did not appear to be as common as indicated on the Long (8) and Dawson (3) lists.

*Synedrella nodiflora (L.) Gaertn.

Hill 16, 24; Dawson 19800; Long 1799, 1801, 1811, 2859; Herbst 8821.

Collections are from Menge, Cooper, and Kaula Islands.

ASTERACEAE - continued

*Vernonia cinerea var. parviflora (Reinw.) DC. (ironweed)

Dawson 19833, 19838, 19839; Long 1813; Herbst 8821.

Occasional on Menge and Cooper Islands. Dawson (3) also lists Strawn Island.

BOMBACACEAE

Dawson (3) lists a Bombax cultivated as an ornamental on Menge Island. This is the only record of the family on Palmyra; it was not vouchered.

BORAGINACEAE

Tournefortia argentea L.f. (tree heliotrope)

Rock 10278; Cook s.n.; Judd and Mitchell 13; Bryan 885, 1398; Hill 7; Long 1764, 1777, 2851; Herbst 8845.

Typically forming the vegetation line back of the beach. One of the dominant tree species of Palmyra.

BRASSICACEAE

Lepidium bidentatum Mont.

Streets, s.n.; Rock 10277; Judd and Mitchell 15; Bryan 1397.

Noted as common by Streets in 1873 (13); according to Rock (10), in 1913 it was common only on Cooper and Strawn Islands. It was last collected by Bryan (1) in 1938, and may now be extinct on Palmyra. Recorded as L. owaihiense C. & S. in earlier literature.

*Raphanus sativus L. (radish)

According to Dawson (3), radishes were one of the vegetables grown in the gardens of the Civil Aeronautics Authority personnel stationed on Palmyra.

CARICAEAE

*Carica papaya L. (papaya)

Papaya has been planted on Palmyra frequently in the past. A severe storm in January, 1958, destroyed many of the cultivated plants on the atoll, including the papaya (3); it has not been planted on the island since.

CASUARINACEAE

*Casuarina equisetifolia L.

Dawson 19828; Herbst 8847.

Observed by Long on Tanager and Cooper Islands in 1964, who noted that the trees on Cooper Island appeared to be reproducing.

CLUSIACEAE

*Calophllum inophyllum L. (kamani)

Dawson 19829, 19851, 19863; Long 1770; Herbst 8858.

Recorded from Menge and Papala Islands.

COMBRETACEAE

*Terminalia catappa L. (false kamani)

Hill 1; Dawson 19824; Long 2839, 2847; Herbst 8866.

Originally planted on Menge Island and has now spread to other islands; in 1987, it was observed on Aviation, Engineer, Menge, Quail, and Tanager Islands.

CONVOLVULACEAE

Ipomoea macrantha R. & S.

Bryan 1401; Dawson 19837; Long 1787; Herbst 8859.

Observed by Rock in 1913 on Papala, Cooper, and Eastern Islands. Recorded in earlier literature as I. glaberrima Bojer, I. tuba (Schlecht.) G. Don, and I. grandiflora (Choisy) Hall f.

DICOTYLEDONAE - continued

CONVOLVULACEAE - continued

*_Ipomoea pes-caprae_ ssp. _brasiliensis_ (L.) V. Ooststr.

(beach morning glory)

Dawson 19802; Long 1812; Herbst 8846.

Observed only on Menge and Cooper Islands. It was first found along the runway, and may have been unintentionally introduced along with passengers or cargo.

CUCURBITACEAE

Capt. Zenas Bent reported having planted water melons (_Citrullus lanatus_ (Thunb.) Matsum. and Nakai) on Palmyra in 1862 (10); Fullard-Leo (6) also reported that melons had been planted on Palmyra.

EUPHORBIACEAE

*_Acalypha wilkesiana_ Muell.-Arg. (Jacob's coat)

Long 2856.

Collected only in 1964 by Long who reported it to be an ornamental planted near the mess hall on Cooper Island.

*_Chamaesyce hirta_ (L.) Millsp. (hairy spurge)

Hill 15; Herbst 8816.

Common in open, disturbed areas on Menge and Cooper Islands.

*_Chamaesyce hypericifolia_ (L.) Millsp.

Hill 17, 23; Dawson 19809; Herbst 8822.

Reported in earlier literature as _Euphorbia hypericifolia_ L. or _E. glomerifera_ (Millsp.) L.C. Wheeler. The Hill specimen identified as _E. atoto_ Forst. f. in Dawson (3) also belongs here. The species was observed by Long in 1964.

EUPHORBIACEAE - continued

*_Codiaeum variegatum_ (L.) Bl. var. _pictum_ (Lodd.) Muell.-Arg (croton)

Dawson (3) reports observing crotons in cultivation on Palmyra.

*_Euphorbia cyathophora_ Murr.

Hill 22; Dawson 19831; Herbst 8817.

Also known as _E_. _heterophylla_ var. _cyathophora_ (Murr.) Griseb.

*_Euphorbia pulcherrima_ Klotzch (poinsettia)

According to Dawson (3) poinsettias were grown in the gardens of Civil Aeronautics Authority personnel.

*_Phyllanthus amarus_ Schum.

Dawson 19827; Herbst 8820.

Misidentified in earlier literature as _P_. _niruri_ L. and _P_. _debilis_ Willd. Long (8) mentions that he was unable to find this species during his survey in 1964.

FABACEAE

Caesalpinia major (Medik.) Dandy & Exell (yellow nickers)

Herbst 8870.

A single seedling was found in the debris line on the north side of Menge Island. New to Palmyra.

*_Crotalaria incana_ L. (fuzzy rattle-pod)

Dawson 19801; Long 2850; Herbst 8833.

Naturalized in gravel at the top of the seaplane ramp and around the buildings on Menge Island.

DICOTYLEDONAE - continued

FABACEAE - continued

Entada phaseoloides (Stickm.) Merr. (St. Thomas bean)

Herbst 8853.

Nine seedlings of a legume, probably this species, were found growing in the debris line on the north side of Menge Island. Obviously, the seeds floated in from some other island group. If the plant becomes established, it will be a new addition to the Palmyra flora.

**Leucaena leucocephala* (Lam.) deWit (koa haole)

Dawson 19826; Herbst 8863.

Localized on Menge Island, but seeding itself and undoubtedly will spread.

**Phaseolus* sp. (beans)

Fullard-Leo (6) reported that several vegetables, including beans, had been planted on Palmyra. He probably was referring to a member of this genus. Capt. Zenas Bent stated in a report that he had planted beans on Palmyra in 1862 (10).

GOODENIACEAE

Scaevola sericea Vahl (naupaka)

Bryan 1400; Judd and Mitchell 16; Hill 6; Long 1743, 1795, 1798, 2831, 2834, 2862, 2865; Herbst 8857.

Dawson (3) reports that *Scaevola* was "widely observed throughout the atoll." Although it was not collected or mentioned by Rock in his publications of 1916 and 1929, it is highly probable that it was present and is here accepted as a native component of the flora. A small colony on the north shore of Menge Island, and another on the south shore of Strawn Island have pale yellow flowers. Long (8) referred these plants to *S. taccada* var. *tuamotuensis* St. John. As they grow mixed with, and in all other characteristics are identical to the white flowered form, I believe they represent only a minor variation in the local population of the species. The synonyms *S. taccada* (Gaertn.) Roxb. and *S. taccada* var. *sericea* (Vahl) St. John are used in some of the literature on the Palmyra flora.

HERNANDIACEAE

Hernandia _sonora_ L.

Herbst 8868.

A single tree, about 30 ft. tall and with an approximate diameter at breast height of 7 inches was found at the edge of the vegetation on the north side of Quail Island. Four seedlings ranging from 5 to 18 inches tall, were observed in the debris and vegetation lines on the north shore of Menge Island. Previously unrecorded from Palmyra.

LAURACEAE

*_Persea_ _americana_ Mill (avacado)

A single young tree was observed by Herbst in 1987. It was about five feet tall and had been planted at the head of the seaplane ramp. Not previously reported from Palmyra.

MALVACEAE

*_Hibiscus_ _rosa-sinensis_ L. (hibiscus)

Observed by Herbst in 1987. Three plants were growing by the buildings on Menge Island. Previously unreported from Palmyra.

*_Hibiscus_ _tiliaceus_ L. (hau)

Hill 5; Dawson 19803; Long 1775; Herbst 8855.

Observed on Menge, Cooper, Pelican, Engineer, Strawn, Tanager, and Marine Islands.

*_Sida_ _rhombifolia_ L. (Cuba jute)

Herbst 8838.

A small patch of a dozen or so plants are growing along the path on Cooper Island. New island record.

DICOTYLEDONAE - continued

MALVACEAE - continued

**Thespesia populnea* (L.) Correa (milo)

Long 1796.

Long (8) reported that it was introduced to Cooper Island, but not spreading. It was not seen in 1987.

MORACEAE

**Artocarpus altilis* (Parkins. ex Z.) Fosb. (breadfruit)

At the request of the owner of the island, personnel from the Coast Guard Cutter Itasca planted three koa and three maopo breadfruit on Home and Cooper Islands in 1936 (7). These are no longer extant. Five young trees have been planted recently near the head of the seaplane ramp.

**Morus* sp. (mulberry)

Kenner (7) reported that 35 mulberry cuttings had been planted, half each on Home and Cooper Islands. They are no longer on the islands.

MYRTACEAE

**Syzygium malaccense* (L.) Merr. & Perry (mountain apple)

A single, young, cultivated plant, about 3 ft. tall, was observed in 1987 near the head of the seaplane ramp. Not previously reported from Palmyra.

NYCTAGINACEAE

Boerhavia tetrandra Forst. f. (alena)

Rock 10273; Bryan s.n.; Judd and Mitchell s.n.; Dawson 19844; Long 1788, 1814, 2832, 2864; Herbst 8843.

Common in open, sandy sites at least on Cooper and Strawn Islands.

NYCTAGINACEAE - continued

Pisonia grandis R. Br.

Rock 10274; Cooper 10275; Cooke s.n.; Bryan 884; Dawson 19862; Long 1776c, 1803; Herbst 8825.

Occasional to common on most of the islands. It is the largest and one of the most common trees on Palmyra, forming pure stands of trees up to 80 ft. tall.

ONAGRACEAE

*_Ludwigia octivalvis_ (Jacq.) Raven (primrose willow)

Hill 25, s.n.; Dawson 19834; Herbst 8873.

Collected on Cooper and Menge Islands. Observed by Long in 1964.

PASSIFLORACEAE

*_Passiflora edulis_ Sims (passion fruit)

Kenner (7) reported that six purple fruited forms (f. _edulis_) and six yellow fruited forms (f. _flavicarpa_ Deg.) of passion fruit were planted on Home and Cooper Islands in 1936. They have not persisted.

POLYGONACEAE

*_Coccoloba uvifera_ (L.) L. (sea grape)

Hill 2; Dawson 19864; Long 1796; Herbst 8830.

Six sea grapes were planted on Home and Cooper Islands by personnel of the Coast Guard Cutter Itasca in 1936 (7). This species has since been collected or observed on Menge, Marine, Engineer, Quail, Tanager, Holei, and Cooper Islets. These plants probably are all descendants from the 1936 planting.

PORTULACACEAE

*Portulaca oleracea L.

Dawson 19825a; Long 1792; Herbst 8840.

The identification of this plant is tentative. It was originally described as P. fosbergii v. Poelln., which probably is conspecific with P. oleracea. Rock (10) reported having seen P. oleracea on Holei Island during his survey of Palmyra in 1913.

ROSACEAE

*Rosa sp. (rose)

It is reported in Dawson (3) that personnel of the Civil Aeronautics Authority planted roses in their gardens in Palmyra.

RUBIACEAE

Guettarda speciosa L.

Hill 1; Herbst 8867.

A single tree, about 20 ft. tall and with a diameter at breast height of about 4 inches, was seen. It is growing in the vegetation line on the north shore of Quail Island.

*Spermacoce assurgens R. & P. (buttonweed)

Dawson 19807; Long 1764, 1823, 2843; Herbst 8818, 8826.

Very common weed of open disturbed areas, Cooper Island; also observed on Papala, Engineer, and Menge Islands. It is listed as Borreria laevis (Lam.) Griseb. in earlier literature on the Palmyra flora.

RUTACEAE

*Citrus aurantium L. (orange)

Kenner (7) reports planting three grafted Hawaiian orange trees on Home and Cooper Islands. Apparently they did not persist.

SIMAROUBACEAE

Suriana maritima L.

Streets, s.n.; Herbst 8871.

Streets (13) indicates that this plant was collected on Palmyra. A seedling of this species was collected from the debris line on the north side of Menge Island in 1987.

SOLANACEAE

*Lycopersicon esculentum Mill. (tomato)

Both Fullard-Leo (6) and Dawson (3) reported that tomatoes had been planted on Palmyra; they are no longer on the atoll.

TILIACEAE

Triumfetta procumbens Forst. f.

Dawson 19838, 19848; Long 2836; Herbst 8841.

Collected on Strawn, Menge, and Cooper Islands.

URTICACEAE

Laportea ruderalis (Forst. f.) Chew

Rock 10282; Cooke s.n.; Bryan 882, 1399; Judd and Mitchell 11; Dawson 19835; Long 1763, 1778, 1788, 1791, 1802, 1816, 2833; Herbst 8842.

Common in open areas where it forms extensive stands; occasional, scattered plants in forested areas. Reported in the earlier literature as Fleurya ruderalis (Forst. f.) Gaud., a synonym.

*Pilea microphylla (L.) Liebm. (artillery plant)

Hill 18; Dawson 19808; Long 1765, 1815, 2837; Herbst 8831.

Naturalized around the buildings on Cooper Island.

VERBENACEAE

Premna obtusifolia R. Br.

Herbst 8864.

Locally common, western Menge Island. This species probably arrived on Palmyra by some natural means, perhaps a seed in the gut of a plover. First report of this species on Palmyra.

*_Stachytarpheta jamaicensis_ (L.) Vahl

Dawson 19810; Herbst 8869.

Sparingly naturalized in open disturbed sites on Menge Island.

*_Stachytarpheta urticifolia_ (Salisb.) Sims

Hill 11; Long 2851; Herbst 8834.

Disturbed sites on Menge and Cooper Islands.

*_Vitex trifolia_ L.

Hill 4; Dawson 19825; Herbst 8824.

An ornamental shrub that persists, or perhaps is sparingly adventive on Cooper Island. Cited as _V. negundo_ var. _bicolor_ (Willd.) H. Lam in Dawson (3).

VIOLACEAE

*_Viola_ sp. (violet)

Dawson (3) reports that Civil Aeronautics Authority personnel stationed on the atoll grew several ornamental plants, including violets, in their gardens.